INSTRUCTION MANUAL

MODEL 101T-638

AC POWER SOURCE

Invertron®

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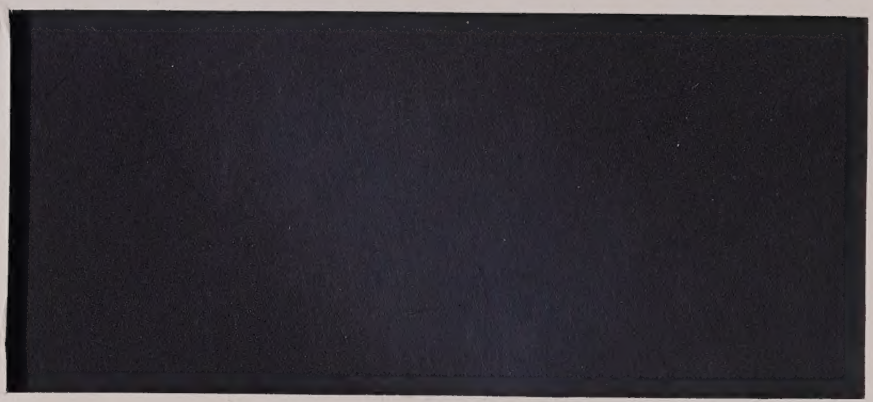

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Revision J
February 1982

INSTRUCTION MANUAL

MODEL 101T-638

AC POWER SOURCE

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MANUAL ADDENDUM

Model 101T-638

1.0 GENERAL:

The Model 101T-638 AC Power Source is identical to the standard Model 101T AC Power Source except the Model 101T-638 has an output of 0-35 volts rms.

2.0 SPECIFICATIONS:

All specifications are identical to the standard Model 101T except full power is available from 35 volts rms to 27.3 volts (78% of rated output voltage) and a 0 to 40 voltmeter is used in place of the 0 to 160 voltmeter.

3.0 THEORY OF OPERATION:

The theory of operation section given in section 3.0 of the standard 101T manual is applicable except that the output transformer T2 is replaced with an output transformer whose secondary voltage is 35 volts rms rather than 135 volts rms.

4,0 The calibration procedure given in section 4.0 of the standard 101T manual is applicable except that the full load resistance at 35 volts output is 12.25 ohms rather than 182 ohms and that the full load resistance at 78% of rated output voltage is 7.46 ohms rather than 110 ohms. Line regulation, load regulation, amplitude stability, frequency response and AC noise level tests given in section 4.6 through 4.10 of the standard manual are correct except that the load resistance values are changed to 12.25Ω when S1 is closed and 7.46 ohms when S2 is closed. Test data tolerances are further restricted by the ratio of 135V to 35V or 3.85 to 1.

5.0 PARTS LIST:

Parts list 4995-410 defines part substitutions required to the standard Model 101T.

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LIST OF DRAWINGS

ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
None	C4010-900	OUTLINE DRAWING
None	E4010-400	FINAL ASSEMBLY
A1	D4010-700	AMPLIFIER AND HEATSINK ASSY
A2	D4010-701	HEATSINK ASSEMBLY
A1 and A2	E4010-070	SCHEMATIC

SPECIFICATIONS

MODEL 101T AC POWER SOURCE

All specifications are tested in accordance with standard California Instruments test procedures and apply with a stable, low distortion input signal such as supplied from a T series plug-in oscillator.

POWER OUTPUT:	100 VA at 105 to 135 volts rms output from unity to ±0.7 power factor. See derating chart for operation at other output voltages and/or power factor.
*OUTPUT VOLTAGE RANGE:	0 to 135 volts rms.
TOTAL HARMONIC DISTORTION:	Less than 0.30% distortion from 200 Hz to 1 KHz; less than 0.5% distortion from 45 Hz to 10 KHz.
AMPLITUDE STABILITY: (after one hour warm-up)	±0.25% for 24 hours at constant line, load and ambient temperature conditions.
LOAD REGULATION:	±1% over the range from 45 Hz to 5 KHz and ±2% over the range from 45 Hz to 10 KHz when tested at unity power factor. In addition, a load regulation adjustment permits the regulation to be adjusted to zero at any given line voltage, signal frequency and load conditions. Control resolution is 0.1%.
LINE REGULATION:	±0.25% of full output for a ±10% line change.
**FULL POWER FREQUENCY RANGE:	45 Hz to 10 KHz.
FREQUENCY RESPONSE:	±0.5 dB from 45 Hz to 10 KHz.
AC NOISE LEVEL:	80 dB below full output when tested with a shorted input; 70 dB below full output when tested at full rated power output.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Complete protection from overloads and short circuits is provided. Automatic reset occurs when overload is removed.

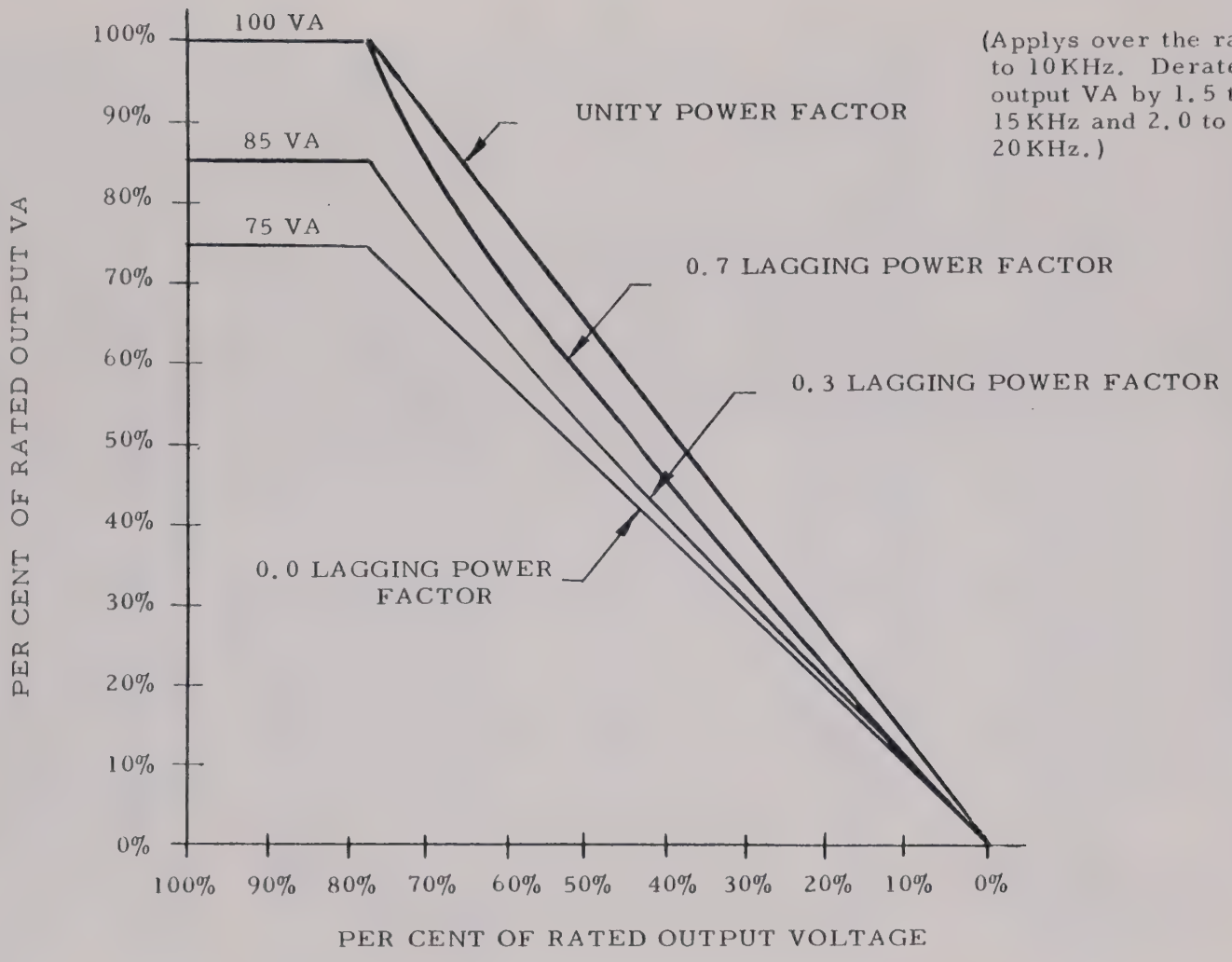
*Other output voltage ranges available on special order, consult factory.

**This power source may be used over the 20Hz to 20KHz frequency range provided the output voltage and the output VA are derated according to Table 2-2 in this instruction manual; otherwise permanent damage to the unit may occur.

AMPLIFIER DRIVE REQUIREMENTS: (Normally obtained from plug-in)	5 volts rms (maximum) produces 135 volts rms.
AC INPUT LINE:	105 to 125 volts rms. Unit may be wired for the following single phase voltages on special order: 208 VAC, 220 VAC, 230 VAC and 240 VAC.
AC INPUT FREQUENCY:	48 to 65 Hz. (400 Hz available on special order.)
AC INPUT POWER:	400 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 55°C.
FRONT PANEL METER:	0 to 160 volt AC voltmeter provides ±1% of full scale accuracy at 400Hz and ±3% of full scale accuracy over the range from 45Hz to 10KHz.
DIMENSIONS:	3 1/2" high x 19" wide x 17.5" deep.
NET WEIGHT:	40 lbs.
SHIPPING WEIGHT:	45 lbs.
FRONT PANEL FINISH:	Grey, 26440 per Federal Standard 595 with black silk-screened lettering.

DERATING CHART
FOR 101T
POWER AMPLIFIER

(Applys over the range from 45 Hz to 10 KHz. Derate the curve for output VA by 1.5 to 1.0 factor at 15 KHz and 2.0 to 1.0 factor at 20 KHz.)



GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration and maintenance of the California Instruments Model 101T Power Source. Detailed schematics, parts location drawings, calibration procedures and theory of operation are also contained for the aid of maintenance personnel.

1.2 GENERAL DESCRIPTION

The California Instruments Model 101T Power Amplifier is a solid state, high performance, low distortion power source that provides up to 100 VA output when used with the proper California Instruments Oscillator. The Model 101T Power Source is illustrated in Figure 1-1. Full power output is available from 105 volts to 135 volts rms and from 45Hz to 10KHz.

For two phase and three phase operation, at least two power amplifiers must be combined together with the applicable multi-phase oscillator. Two power amplifiers will provide a total of 200 VA two phase power, or 200 VA of three phase power in the open delta configuration. Three power amplifiers will provide 300 VA of three phase power in the wye configuration.

1.3 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments Model 101T Power Source.

1.3.1 Zero Manufacturing Company Model C300S-18 rack slides. These rack slides may be bolted directly to the sides of the unit, if required.

1.3.2 Series 800T Variable Frequency Oscillators. These general purpose Wien bridge oscillators provide one phase, two phase or three phase outputs over the range from 20 Hz to 20 KHz in three bands. Units with single phase output are designated as 800T-20/20K-1-1ϕ, two phase oscillators are designated as 800T-20/20K-1-2ϕ and three phase oscillators are designated as 800T-20/20K-1-3ϕ. Calibration accuracy is ±1 per cent at 25°C and amplitude stability is 0.25 per cent per 24 hours at 25°C. The total harmonic distortion is less than 0.25 per cent from 20 Hz to 20 KHz. Several versions of the 800T oscillator are also available which operate over a more restricted frequency range, but which provide improved frequency resolution.

1.3.3 Series 810T Fixed Frequency Oscillators. These oscillators provide one phase, two phase or three phase outputs over the range from 45 Hz to 10 KHz. Units with single phase output are designated as 810T-Freq-.1-1ϕ, two phase oscillators are designated as 810T-Freq-.1-2ϕ and three phase oscillators are designated as 810T-Freq-.1-3ϕ. Frequency accuracy is ±0.1 per cent at 25°. Amplitude stability is ±0.01 per cent per 24 hours at 25°C and varies less than .0025 per cent per degree centigrade. Harmonic distortion is less than 0.1 percent from 45Hz to 5KHz.

1.3.4 Series 812T Open Delta Servo Oscillators. These oscillators provide a three phase output for driving two Invertron® power sources in an open delta configuration. The Model 812T oscillator contains two amplitude servos and one angle servo to provide a closed loop three-phase AC power system with ±0.01% line and load regulation. Units normally encorporate three front panel selectable output frequencies of 50, 60 and 400 Hz. The system output voltage can be varied from 110 to 120 volts with ±0.1 per cent amplitude tracking and less than 0.25 per cent system distortion. Crystal controlled versions of this oscillator are available on special order.

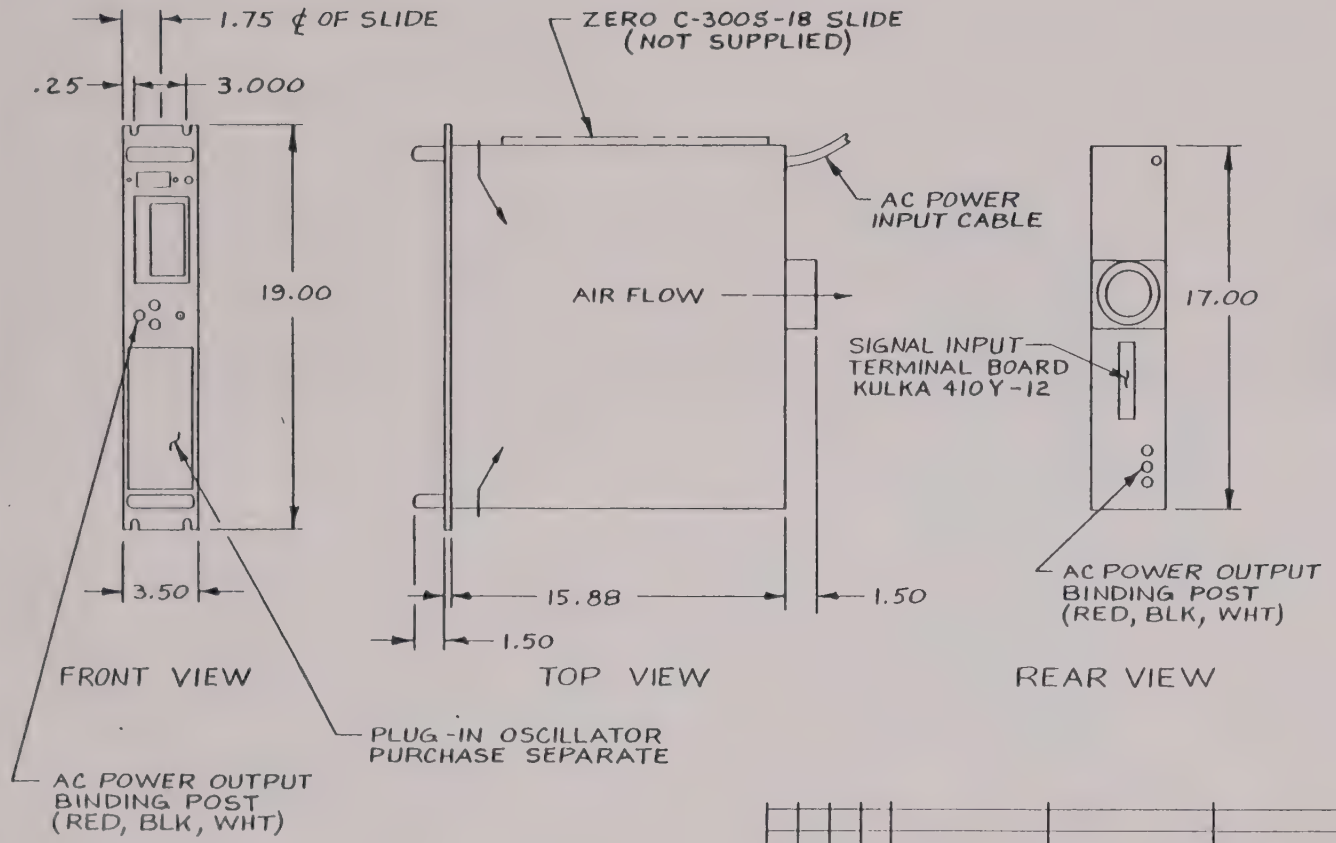
1.3.5 Series 815T Fixed Frequency Oscillators. These low-cost fixed frequency oscillators provide one phase, two phase or three phase outputs over the range from 45 Hz to 10 KHz. Units with single phase output are designated as 815T-Freq-.1-1o, two phase oscillators are designated as 815T-Freq-.1-2o and three phase oscillators are designated as 815T-Freq-.1-3o. Frequency accuracy is ±0.1 per cent at 25°C. Amplitude stability is ±.25 per cent per 24 hours at 25°C and varies less than 0.02 per cent per degree centigrade. Harmonic distortion is less than 0.2 per cent from 45 Hz to 10 KHz.

1.3.6 Series 820T Fixed Frequency Crystal Oscillators. These oscillators provide one phase, two phase or three phase outputs over the range from 45 Hz to 20 KHz. Units with single phase output are designated as 820T-Freq-Accuracy-1o, two phase oscillators are designated as 820T-Freq-Accuracy-2o and three phase oscillators are designated as 820T-Freq-Accuracy-3o. Frequency accuracy is ±0.01 per cent or ±0.0001 per cent. Amplitude stability is ±0.25 per cent per 24 hours at 25°C. The total harmonic distortion is less than 0.15 per cent from 45 Hz to 5 KHz.

1.3.7 Series 830T Programmable Oscillators. These oscillators provide one phase, two phase or three phase outputs over the range from 45 Hz to 9.99 KHz. These units are packaged in a separate 5 1/4 inch package which may be mounted below/above the associated power amplifier.

1.3.8 Series 840T Programmable Oscillators. These plug-in oscillators provide one phase. two phase or three phase output at 380, 400 and 420 Hz. Frequency accuracy is ±0.1 per cent of programmed value. Servo feedback is taken from the output of each phase back to the 840T programmable plug-in oscillator and provides an accuracy of ±0.1 per cent of programmed value.

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



1. FRONT PANEL DIMENSIONS PER W.E./E.I.A. STD.

NOTES (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE

DIM IN INCHES
TOLERANCES
XXX = 010
XX = 03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

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TITLE: OUTLINE DRAWING, 100 VA AMPLIFIER

MODEL 101-T

RELEASE
CHECKER
DESIGN
DRFTSMN D Dowd 8/16/70

PURCHASING
PROJ ENGR
CHF ENGR

DASH NO	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALIFORNIA INSTRUMENTS CORP
SAN DIEGO, CALIFORNIA

CONTRACT NO | CODE IDENT 16067

DWG NO. C4010-900 | REV /

SCALE 1/4 | SHEET 1 OF 1

CALICO F 182

C4010-900 /

WARNING

HIGH VOLTAGE (250 VAC)

Voltages up to 250 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with pin C and pin D of the plug in oscillator, the primary power circuits, and the output circuits of the power source

2.1 UNPACKING

The California Instruments Model 101T Power Source is shipped in a cardboard container with protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

2.2.1 The Model 101T Power Source has been designated to operate from any one of the following AC line voltages, 115 volts, 208 volts, 220 volts, 230 volts or 240 volts rms. The power transformer is normally wired at the factory for operation from the 115 volt line. Table 2-1 below indicates how the primary connections to the power transformer are made for various AC input line voltages.

TABLE 2-1

NOTE

Prior to reconnection power transformer T1, remove all existing jumpers from the primary winding.

Nominal Input Voltage	Operating Line Voltage Range	Power Transformer Connections	Front Panel Circuit Breaker Value
115 volts rms	105-125 volts rms	jumper pins 1 and 3; jumper pins 2 and 6; connect load side of circuit breaker to pin 6.	5 ampere
208 volts rms	190-226 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 4.	3 ampere
220 volts rms	201-239 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 5.	3 ampere
230 volts rms	210-250 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 6.	3 ampere
240 volts rms	219-261 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 7.	3 ampere

2.2.2 The Model 101T has been designated to operate over the line frequency range from 48 to 65 Hz. On special order, units will be supplied to operate from the 400 Hz line.

2.2.3 The normal input power, at 100 VA output, is between 250 and 400 watts depending on line and load conditions. During "turn-on" the peak transient will generally exceed 1000 watts.

2.3 CIRCUIT BREAKER REQUIREMENTS

The Model 101T Power Source uses a 5 ampere Heinemann AM12-5A curve 5 circuit breaker for operation from the 115 volt AC line. A Heinemann AM12-3A curve 5 circuit breaker is used for operation from the 208 volt through 240 volt AC lines. Substitution of circuit breaker type or current rating may cause permanent damage to the unit.

2.4 OUTPUT VOLTAGE AND METER RANGE

The Model 101T Power Source has a single output voltage range from 0 to 135 volts rms. The full scale front panel voltmeter range is 160 volts rms. The Model 101T is available with other output voltage ranges on special order.

2.5 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good condition, perform the following:

2.5.1 Connect the AC line cord to an AC power line of the proper voltage and frequency as determined by either the serial number tag on the unit or by inspection of the wiring to the primary of the power transformer (see Section 2.2.1 of this instruction manual). Connect a 1 KW Variac and a 1.0 KW watt-meter in series with the AC line. The Model 101T Power Source should draw less than 60 watts under no load conditions at mid-line voltage.

2.5.2 Using either a California Instruments 800T Series Oscillator or a suitable external low distortion sine wave oscillator, set the oscillator to the desired frequency (between 45 Hz and 10 KHz) and adjust the output of the oscillator to 5 volts rms. The amplifier input is available at pin 2 (tie oscillator ground to pin 1) of the 12 pin terminal strip TB1 located on the rear of the unit, if the external oscillator is employed. Tie a jumper strap from pin 2 to pin 3 of TB1 if an 800T Series Plug-in Oscillator is being used as the signal source.

2.5.3 The output voltage range is given in Section 2.4 of this instruction manual. The following table lists the proper external load for full power output.

Output Voltage Range	Output Voltage	Full Power Load Resistance	50 Per Cent Power Load Resistance
0-135 volts rms	135 volts rms	182 ohms	364 ohms

2.5.4 Connect 182 ohm, 100 watt load resistor to the red and white binding posts on the rear of the power source. Connect a Tektronix Model 533A Oscilloscope or equivalent across this load resistor.

2.5.5 Using the GAIN control and the front panel METER, set the output voltage of the power source to 135 volts rms. The power line wattmeter should read between 200 and 300 watts at mid-line voltage. Check on the oscilloscope for peak clipping or excessive distortion of the sine wave output.

2.5.6 With the output still adjusted as determined in 2.5.5, place the 364 ohm resistor in parallel with the external load resistor to provide a 50 per cent overload on the output of the power source. The signal on the oscilloscope should exhibit significant clipping on both the positive and negative peaks.

2.5.7 Remove the 50 per cent overload resistor and the output should automatically return to normal.

2.5.8 Place a short circuit in parallel with the external load resistor and then remove the short circuit after a few seconds. The signal on the oscilloscope should go to zero and then return to normal when the short circuit is removed. The front panel circuit breaker may be activated if the short circuit remains across the output for a long period of time.

2.5.9 The CALIBRATION PROCEDURE given in Section 4.0 of this manual should be followed if a more detailed evaluation of the unit is required at this time.

2.6 MECHANICAL INSTALLATION

The Model 101T Power Source has been designed for rack mounting in a standard 19 inch rack. The unit should be supported from the bottom with a shelf-track or supported from the sides with a pair of rack slides (Zero Manufacturing type C300S-18 or equivalent).

The cooling fan on the rear of the unit must be free of any obstructions which would interfere with the flow of air. A 1.5 inch clearance should be maintained between the rear of the fans and the rear door of the mounting cabinet. Also, the air intake holes on the sides of the power source must not be obstructed.

2.7 INPUT POWER WIRING

The Model 101T Power Source will operate from single phase input voltages from 105 volts to 260 volts rms in five ranges as described in Section 2.2 of this manual. The power source should be used with 115 volt power lines with a capacity of 10 amperes or greater. If 200 to 260 volt AC lines are used, their capacity should be 5 amperes or greater.

2.8 OUTPUT POWER WIRING

The power output wires should be large enough to avoid excessive line voltage drops. The internal regulation control is capable of providing greater than 2 per cent over-regulation for all normal load conditions. If it is desired to provide a zero output impedance at the load side of the power wiring, it is necessary that these line drops be limited to approximately 1 to 2 per cent of the required output voltage. The following table lists the minimum acceptable wire size for a 1.0 per cent line drop assuming a 100 VA output at a distance of 20 feet from the power source to the load.

Output Voltage	Maximum Line Drop	Load Current	Loop Length	Minimum Required Wire Size
115 volts	1.15 volts	0.87 amperes	40 ft.	#25

The wire size should be reduced 3 sizes every time that the distance between the power source and load is doubled.

2.9 FRONT PANEL CONTROLS

2.9.1 The circuit breaker, located on the front panel of the Model 101T Power Source, is used to switch the POWER to the unit "on." At this time the amber indicator lamp located above this circuit breaker should glow.

2.9.2 The GAIN control is used to adjust the output voltage level of the power source. In the case of a multi-phase power source, the gain control is turned nearly fully clockwise and then used as a fine gain trim control. The amplitude of the output of the multi-phase system is controlled by the amplitude control located on the multi-phase oscillator.

2.9.3 The METER has a range of 0 to 160 volts AC and is used to read the value of the AC output voltage for normal applications of the power source.

CAUTION

This power source must not be driven at signal frequencies below 20 Hz or above 20 KHz, otherwise permanent damage to the unit may occur. For operation in the region between 20 Hz and 45 Hz and for operation in the region between 10 KHz and 20 KHz, derate the output voltage and output power according to Table 2-2 in order to provide reliable operation of the power source.

TABLE 2-2

Output Frequency	Maximum Safe Output Voltage on 0 to 135 Volt Range.	Maximum VA Output at Maximum Safe Output Voltage with ± 0.7 Power Factor Load.
20 Hz	60 volts rms	52 VA
30 Hz	90 volts rms	85 VA
40 Hz	120 volts rms	100 VA
45 Hz to 10 KHz	135 volts rms	100 VA
15 KHz	90 volts rms	57 VA
20 KHz	67.5 volts rms	30 VA

THEORY OF OPERATION

3.1 GENERAL

The California Instruments Model 101T Power Source is an all silicon solid state 100 VA amplifier and, with companion oscillator, is designed to provide reliable sine wave AC power over the frequency range from 45 Hz to 10 KHz.

A block diagram for the amplifier is shown in Figure 3-1. The pre-amplifier G1 is used to amplify the input signal to such a level so as to supply adequate drive to the power amplifier G2.

The power amplifier G2 provides the necessary sine wave signal to drive the output transformer T2. The output transformer has a floating secondary winding which allows the load to float from the amplifier and oscillator circuitry.

The power amplifier G2 contains the overload and short circuit protection circuitry. A local negative feedback loop is taken from the output of the power amplifier back to the pre-amplifier, G1.

The overall negative feedback is taken from the negative feedback winding on the output transformer back to one input of the pre-amplifier and provides a closed loop gain of 20 from the high side of A1R7 to the primary of T2.

The positive feedback signal is generated by sensing the IR drop across the primary of T2 and applying this signal to transformer A1T1. Transformer A1T1 converts this differential signal into a single-ended signal and applies it to the input of the pre-amplifier through a divider network containing the regulation control A1R3. As this positive feedback is increased from zero with potentiometer A1R3, the output impedance of the power source is reduced toward zero.

Power transformer T1, along with the associated rectifiers and filters, supply the operating voltages for the plug-in oscillator, the pre-amplifier G1 and the output amplifier G2.

3.2 DETAILED CIRCUIT DESCRIPTION

A schematic diagram for the Model 101T Power Source is shown in drawing E4010-070. The large printed circuit board is designated as the A1 assembly and contains the circuitry for the preamplifier and power amplifier section of the power source. For information on the plug-in oscillator, consult the applicable oscillator manual. These drawings give typical voltage levels and waveforms for the various sections of the power source.

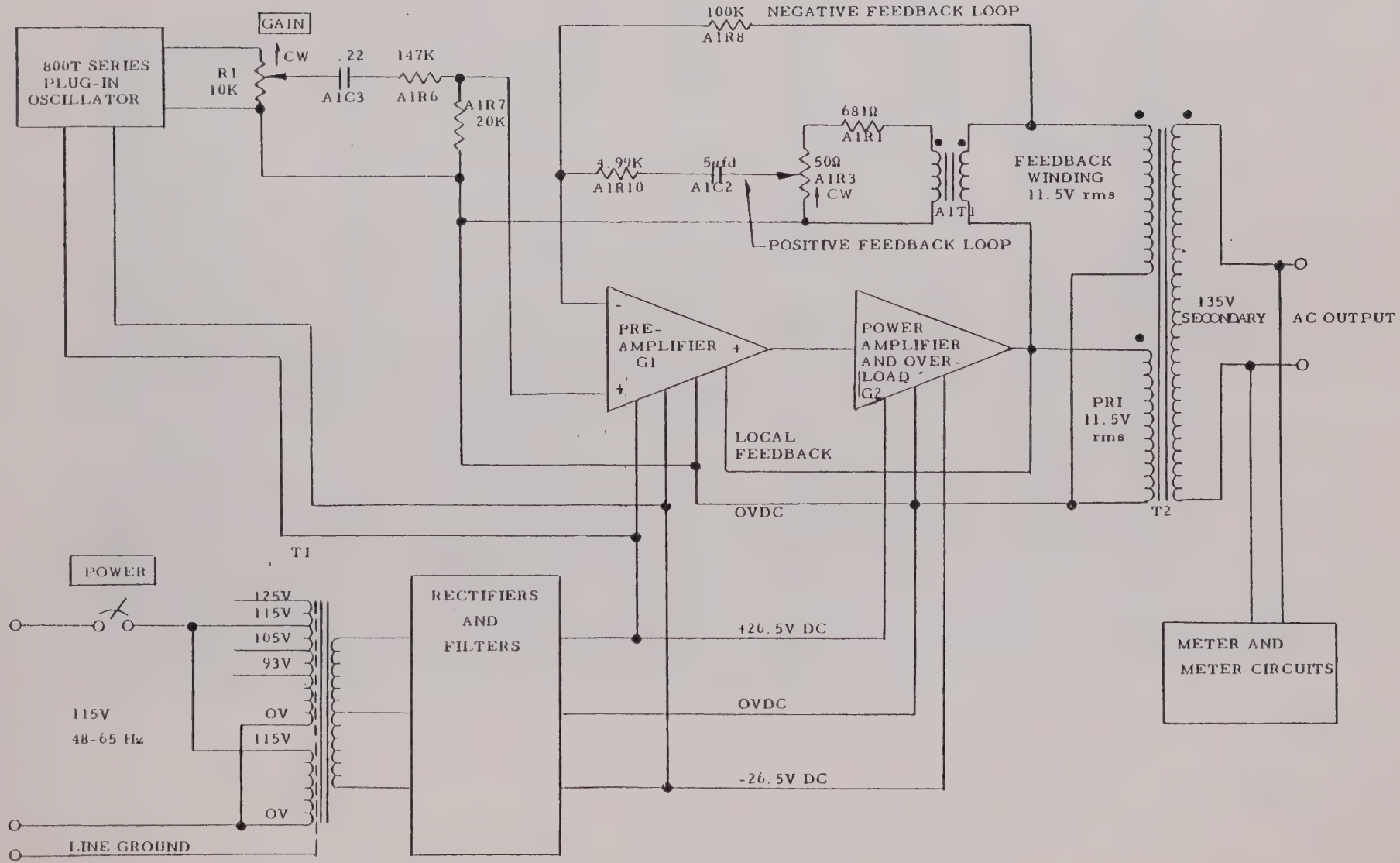


FIGURE 3-1. BLOCK DIAGRAM OF MODEL 101T POWER SOURCE

3.2.1 PRE-AMPLIFIER

The pre-amplifier G1 is a part of the A1 assembly and consists of transistors A1Q1 through A1Q6 and associated components connected as a direct coupled differential amplifier. The open loop gain of this pre-amplifier is approximately 30 at 400 Hz and rolls off at 6 dB per octave above 30 KHz.

Transistor A1Q1 is a dual field effect transistor used in the differential source follower configuration to provide a high input impedance and a gain of approximately 1.0. Potentiometer A1R14 is used to adjust the DC bias at the primary of T2 to zero volts with no signal.

Transistor A1Q2 is a dual transistor used in a differential configuration and provides a gain of approximately 15 at 400 Hz. Capacitor A1C7 and resistor A1R24 provide a high frequency step roll off from 30 KHz to 300 KHz.

Transistor A1Q3 and associated components are connected as a constant current source which provides the emitter current for A1Q2. This current source is designed to sink 2 milliamperes from the junction of A1R17 and A1R18 to the -15 volt supply.

Transistors A1Q4, A1Q5 are used in the differential amplifier configuration and provide an open loop gain of 2 at 400 Hz.

Transistor A1Q6 and associated components are connected as a constant current source which provides 6 milliamperes to the junction of A1R23 and A1R25.

3.2.2 POWER AMPLIFIER

The power amplifier G2 mechanically consist of the remainder of the A1 board and the A2 assembly. Electrically, the power amplifier consist of transistors A1Q7 through A1Q11A and A2Q1 through A2Q3A and associated components.

Transistor A1Q7 and associated components are connected as a constant current source which provides 22 milliamperes to bias the output stage by means of diodes A1CR6 and A1CR7. This allows the output stage to operate as a Class A amplifier for no load or low VA load conditions and to operate nearly as a Class B amplifier for large load conditions.

Transistor A1Q8 and associated components are connected in the ground emitter configuration. Local negative feedback is provided by A1C10, A1C11, A1R42 and A1R43. The local feedback limits the gain of this stage to 24 at 400 Hz. The gain falls off at 6 dB per octave above 30 KHz.

The positive polarity output amplifier is contained on the A2 assembly and consist of A2Q1 through A2Q3 connected as emitter followers. These transistors supply a total of 16 amperes peak during the positive one-half cycle of the output wave form when the power source is loaded to 100 VA output at 78 per cent of rated output voltage (worst case condition within specification limits). These positive output amplifier transistors and their associated heatsink can dissipate over 100 watts with less than a 35°C case temperature rise with an air flow of 10 cfm per heatsink.

The negative polarity output amplifier is contained on the A1 assembly and consist of A1Q9 through A1Q11 connected in the quasi complementary symmetry configuration. These transistors supply a total of 16 amperes peak during the negative one-half cycle of the output wave form when the power source is loaded to 100 VA output at 78 per cent of rated output voltage (worst case condition within specification limits). These negative output amplifier transistors and their associated heatsinks can dissipate over 100 watts with less than a 35°C case temperature rise with an air flow of 10 cfm per heatsink.

The rated VA output of the power source is, to a large extent, determined by the power dissipation in the quasi complementary symmetry output stage. This power dissipation is determined by the power factor of the load, the output VA level of the amplifier, and to the actual output voltage expressed as percentage of the rated output voltage. The derating chart, given in the specifications, expresses this derating in a graphical form.

When the power source is delivering its full rated output voltage, the primary of the output transformer has an 11.5 volt rms signal.

3.2.3 OVERLOAD PROTECTION

The overload protection circuitry is also shown in drawing E4010-070 and consist of zener diode A1CR13, diode A1CR6, A1CR7 and emitter resistors A2R2, A2R3, A1R48 and A1R49.

Diode A1CR13 is used in the zener mode to limit the positive voltage drive to the positive polarity output amplifier (assembly A2) during periods of overload or short circuit. This in turn, limits the output current of the positive polarity output amplifier as determined by the value of emitter resistors A2R2 and A2R3.

Diodes A1CR13 and A1CR7 are used in the normal forward biased mode to limit the negative voltage drive to A1Q9 during

periods of overload or short circuit. This, in turn, limits the collector current available from A1Q9 as determined by the value of emitter resistors A1R48 and A1R49. Since the base drive to A1Q10 and A1Q11 is limited, the corresponding collector current from A1Q10 and A1Q11 will also be limited. Resistor A1R49 is selected to provide symmetrical limiting for both the positive and the negative polarity output amplifiers.

3.2.4 OVERALL NEGATIVE FEEDBACK

The overall negative feedback loop is a single-ended potentiometric feedback loop taken from the negative feedback winding of T2 back to the gate of A1Q1B. The feedback network consists of A1R8, A1R9, A1R10, A1C2 and A1C4 and limits the mid-band closed loop voltage gain of the amplifier to 20 from the gate of A1Q1A to the primary of T2.

This overall feedback loop provides approximately 30 dB of negative feedback over the range from 45 Hz to 20 KHz. The feedback rolls of at approximately 9 dB per octave for frquencies greater than 20 KHz. The purpose of this feedback loop is to insure that the frequency response, distortion, gain and amplitude stability specifications are met and/or exceeded.

A low frequency negative feedback loop is taken from the power primary winding of T2 back to the gate of A1Q1B through A1R11 and A1R12. This loop limits the closed loop voltage gain of the amplifier to 1.6 at DC and thereby provides improved DC bias stability for the amplifier.

3.2.5 POSITIVE CURRENT FEEDBACK

The positive current feedback loop generates a positive feedback voltage proportional to the load current in the secondary of T2. This is accomplished in the following fashion:

The load current in the secondary of the output transformer T2 is reflected back into the power primary winding producing an IR drop across the power primary winding. The negative feedback winding is connected so as to buck out the $L\frac{di}{dt}$ drop in the power primary winding. The remaining differential signal is applied to the primary of transformer A1T1 and converted into a single-ended signal at the secondary of A1T1. This signal is then applied to the gate of A1Q1B through a divider network consisting of A1R1, A1R2, A1R3, A1R10, A1C1 and A1C2. Potentiometer A1R3, which is accessible from the top of A1 printed circuit board, is used to adjust the amount of positive feedback and thereby adjust the output impedance of the power source.

3.2.6 POWER SUPPLY

A schematic diagram for the DC power supply is also a part of drawing E4010-070. This power supply delivers ±26.5 volts ±5 per cent at 4 amperes DC with less than 2 volts peak-to-peak ripple from the 115 volt 60Hz AC line. These unregulated supplies consist of quad rectifier diode CR1 and filter capacitors C1 and C2 connected in a conventional fashion.

3.2.7 FRONT PANEL METER

The front panel meter M1 has a full scale sensitivity of 0 to 1 millampere DC and an internal resistance of approximately 100 ohms. The meter has a single scale with a range of 0 to 160 volts AC. The meter rectifiers and scaling circuitry are a part of the A1 assembly. This meter circuitry consist of rectifier diodes A1CR8 through A1CR11, potentiometer A1R39, and resistors A1R38, A1R47 and A1R52. The four rectifier diodes are connected so as to form a full wave bridge rectifier. Potentiometer A1R39 is used to shunt a small portion of the meter current and thereby provide a full scale sensitivity adjustment.

WARNING

Voltages up to 250 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with pin C and pin D of the plug in oscillator, the primary power circuits, and the output circuits of the power source.

CALIBRATION PROCEDURE

4.1 GENERAL

The following calibration procedure, or any part of it, may be performed on a routine basis to insure that the Model 101T Power Source remains within specified tolerance. This procedure should always be performed after any repairs have been made to the unit. This procedure also covers test methods for the following power source adjustments and specifications:

a) Initial Adjustments

b) AC Line Input Power and Overload Adjustment

c) Voltage, Power Output, and Harmonic Distortion

d) Line Regulation

e) Load Regulation Adjustment

f) Amplitude Stability

g) Frequency Response

h) AC Noise Level

i) 0.7 Lagging Power Factor

j) 0.7 Leading Power Factor

This calibration procedure assumes that the power source will be operated from the 115 volt, 47 to 65 Hz AC line. For higher values of AC line voltage, a 240 volt variac and a 240 volt wattmeter must be substituted for those called out in this procedure. Consult Section 2.2.1 of this instruction manual for operation from other than the 115 volt AC line.

Table 4-1 below illustrates the measurement voltage and impedance level when evaluating the output of the power source.

TABLE 4-1

Rated Output Voltage	135V AC
78% of Rated Output Voltage	105V AC
Resistive Load for 100 VA Output at Rated Output Voltage	~~182Ω~~ 182.25Ω ± 3.5%
Resistive Load for 100 VA Output at 78% of Rated Output Voltage	~~110Ω~~ 107.46Ω ± 3.5%

TEST DATA TOLERANCES RESTRICTED RATIO 385 Hz

Section 2.8 indicates some potential problems associated with output wiring IR drop. When checking load regulation and amplitude stability, care should be taken to use a four-wire connection such that the external load and the measurement equipment have completely separate wiring from the large binding posts at the rear of the power source.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedure assuming that the input line voltage has a nominal value of 115 volts rms. Some equipment substitutions will be required if this is not the case.

a) Oscilloscope, Tektronix 533A with "W" plug-in

b) 1.0KVA Variac, General Radio W10M or equivalent

c) 1.0 KVA Wattmeter, Simpson Electric or equivalent

d) Distortion Analyser, H.P. 330B or equivalent

e) Differential Voltmeter, Fluke 883A or equivalent

f) Multi-range 100 watt load box, or individual 100 watt power resistors, as defined in Table 4-1. Dale type NHL or equivalent

g) Expanded Scale (about 115 VAC) strip chart recorder, Voltron Model 89.038 or equivalent

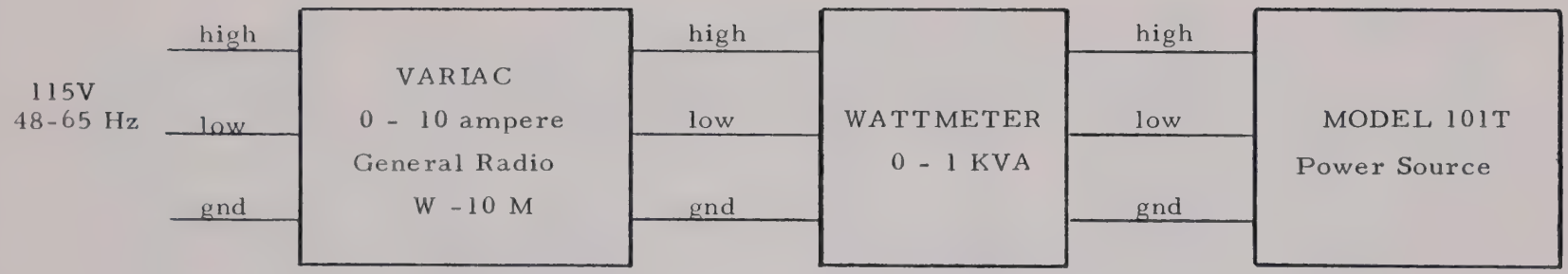
h) Multimeter, Simpson 260 equivalent

4.3 INITIAL ADJUSTMENTS

4.3.1 Connect the Model 101T Power Source as shown in Figure 4-1. Turn the GAIN control fully counter-clockwise. Adjust the line voltage to its nominal value with the variac. Turn the POWER switch "on." The wattmeter should indicate 60 watts or less at nominal line voltage. If a problem is encountered, perform step 4.3.2 below.

4.3.2 Remove the top cover from the unit and connect the differential voltmeter between terminal 1 and terminal 2 of T2. Adjust potentiometer A1R14 so that the DC voltage across the primary of T2 is 0.00 volts ±5 millivolts.

4.3.3 Connect the differential voltmeter to the power output terminals at the rear of the unit. Adjust the GAIN control for a 135 volt output with the oscillator set to 400 Hz. Adjust the meter calibration control A1R39 so that the front panel meter and the differential voltmeter correlate within one per cent of each other. Vary the frequency from 45 Hz to 10 KHz and check that the front panel meter reads within ±3 per cent of the correct value.



See Table 2-1 for AC line input wiring to the Model 101T Power Source. Unit is normally wired for 105 to 125 volt AC line operation.

FIGURE 4-1. Test set up for initial adjustments of Model 101T Power Source.

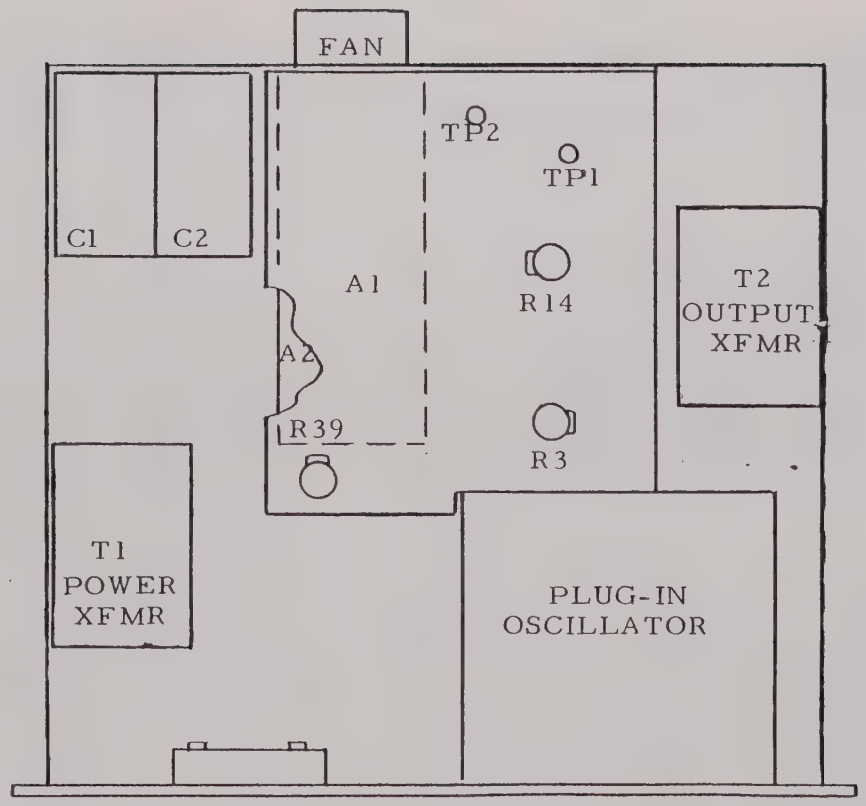


FIGURE 4-2. INTERNAL ADJUSTMENTS FOR MODEL 101T POWER SOURCE

4.4 AC LINE INPUT POWER and OVERLOAD ADJUSTMENT

4.4.1 Connect the Model 101T Power Source as shown in Figure 4-3. Adjust the output voltage of the power source to 105 volts rms (78 per cent of rated output voltage) at 400 Hz. Close switch S2 (110 ohm load) and readjust the output voltage slightly, if required, in order to maintain a 105 volt output. The power source should deliver a clean sine wave output with less than 0.30 per cent distortion. Vary the frequency from 45 Hz to 10 KHz and check that the distortion does not exceed 0.50 per cent over the AC input line voltage range of 105 to 125 volts while maintaining the output voltage at 105 volts rms. Select zener diode A1CR13 so that no clipping or excessive distortion occurs on the positive peak of the output wave form under worst case conditions outlined above. Select resistor A1R49 so that no clipping or excessive distortion occurs on the negative peak of the output wave form under worst case conditions outlined above.

4.4.2 With the AC input line voltage adjusted to its maximum value (normally 125 volts AC), close switch S2 and set the output voltage to 105 volts rms at 400 Hz. The AC line wattmeter should indicate less than 400 watts.

4.4.3 Repeat step 4.4.2 except open switch S2 (no load on output of power source). The AC line wattmeter should indicate less than 100 watts with a line voltage of 125 volts rms.

4.5 VOLTAGE, POWER OUTPUT and HARMONIC DISTORTION

4.5.1 Connect the Model 101T Power Source as shown in Figure 4-3. Adjust the variac to provide a 115 VAC line input and allow the power source to warm up for a few minutes. Set the oscillator output to 400 Hz and adjust the output of the amplifier with the GAIN control to provide 135 volts rms (100% of rated output). Close switch S1 so that the 182 ohm load is across the output of the power source.

4.5.2 Vary the AC line voltage from 105 to 125 volts with the variac and check that no significant clipping is observed on the sine wave output with the oscilloscope. The harmonic distortion must be less than 0.3 per cent over the full line voltage range.

4.5.3 Set the oscillator output to 45 Hz and adjust the output of the power source to 135 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.50 per cent over the full line voltage range.

4.5.4 Set the oscillator output to 1 KHz and adjust the output of the power source to 135 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.30 per cent over the full line voltage range.

4.5.5 Set the oscillator output to 10 KHz and adjust the output of the power source to 135 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.50 per cent over the full line voltage range.

4.5.6 Repeat steps 4.5.1 through 4.5.5 except set the output of the power source to 105 volts rms (78% of rated output) and close switch S2 instead of S1. The harmonic distortion must be less than 0.30 per cent from 200 Hz to 1 KHz, and less than 0.50 per cent from 45 Hz to 10 KHz.

4.6 LINE REGULATION

4.6.1 Connect the Model 101T Power Source as shown in Figure 4-3. Set the oscillator frequency to 400 Hz. Close switch S1 (182 ohm load) and adjust the output of the power amplifier to 135 volts rms (100 per cent of rated output voltage) at 400 Hz.

4.6.2 Vary the line voltage from 105 volts to 125 volts AC and measure the change in output voltage of the power amplifier. This change should be less than .68 volts rms.

4.6.3 Set the frequency of the oscillator to 45 Hz and repeat 4.6.1 and 4.6.2. The change in the output voltage should be less than .68 volts rms.

4.6.4 Set the frequency of the oscillator to 10 KHz and close switch S1. Repeat step 4.6.2. The change in output voltage should be less than .68 volts rms.

4.7 LOAD REGULATION ADJUSTMENT

The load regulation adjustment is accessible after the top cover of the Model 101T Power Source has been removed. This adjustment is usually set for zero regulation at 400 Hz.

4.7.1 Connect the Model 101T Power Source as shown in Figure 4-3. Check that the load is connected to the large red and white binding posts at the rear of the power source. The output voltage may be monitored either at the rear or the front of the power source. If it is monitored at the rear of the power source, care should be taken to use four-wire sensing. Adjust the output voltage of the Model 101T Power Source to 105 V rms output (or 78 per cent of rated output voltage) at 400 Hz.

4.7.2 Place the differential voltmeter on the 1000 volt AC range and connect it across the front panel output terminals of the power source. Adjust A1R3 so that the output voltage variation is less than 100 millivolts as the 110 ohm load is added and removed. Maintain the line voltage at 115 volts during this test.

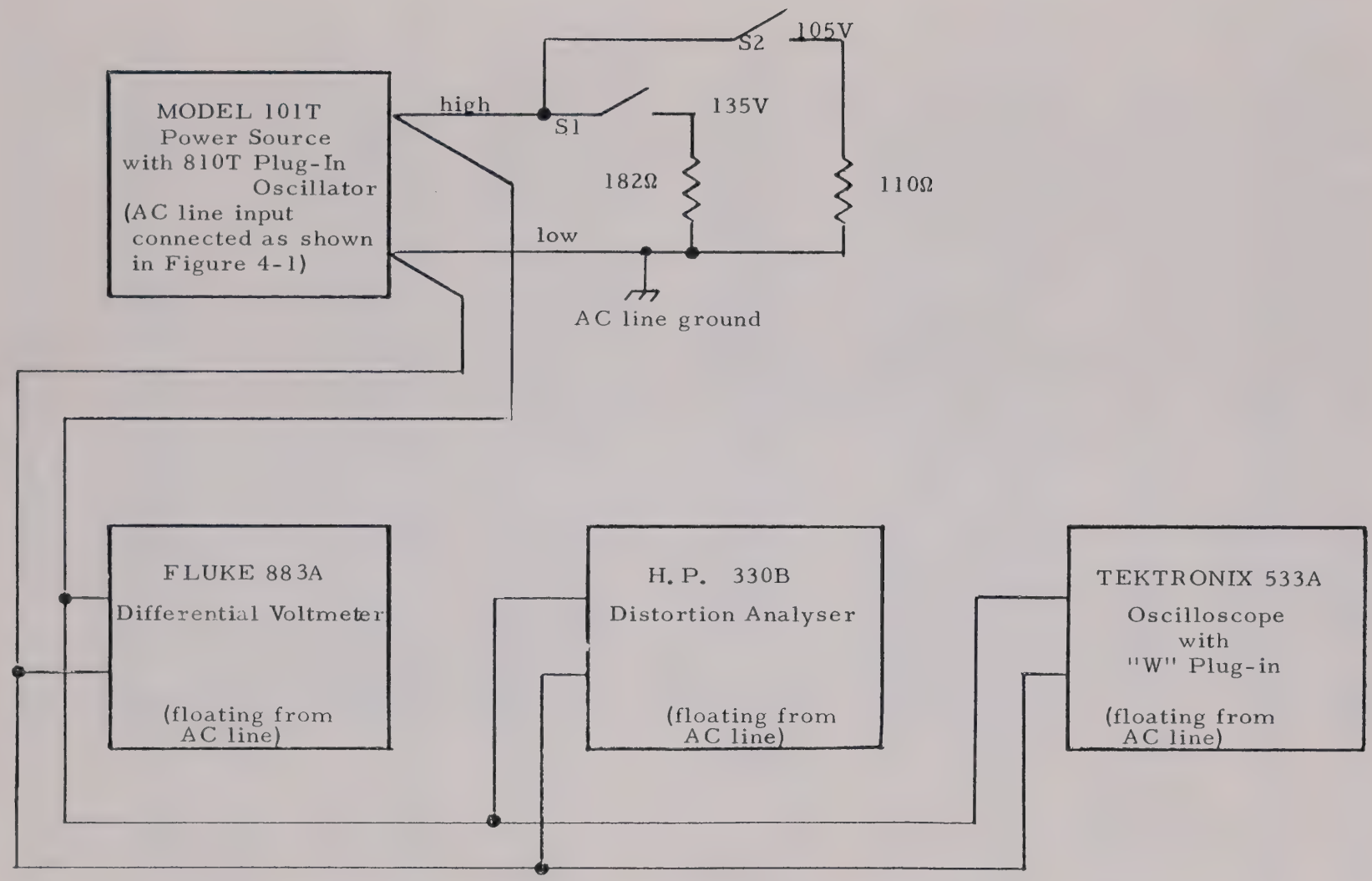


FIGURE 4-3. Test circuit for Model 101T Power Source

4.7.3 Set the frequency of the oscillator to 5 KHz. Adjust the output amplitude of the power source to 105 volts rms with no load on the output of the power source. The output of the power source should change less than ±1.05 volts when loaded with the 110 ohm resistor. Maintain the line voltage at 115 volts during this test.

4.7.4 Set the frequency of the oscillator to 45 Hz and repeat 4.7.3. The output of the power source should change less than ±1.05 volts.

4.7.5 Set the frequency of the oscillator to 10 KHz and repeat 4.7.3. The output of the power source should change less than ±2.10 volts. Capacitor A1C1, in the secondary circuit of A1T1, has been set at the factory for optimum load regulation at 10 KHz and may be changed if required. Care should be taken to use non-inductive load resistors since load impedances are fairly low and a few micro henrys of inductance will significantly influence the power factor at 10 KHz.

NOTE

Care should be taken to insure that the output amplitude of the oscillator remains stable and independent of load conditions during this test.

4.8 AMPLITUDE STABILITY

4.8.1 Connect the Model 101T Power Source as shown in Figure 4-3. Adjust the AC input line voltage to 115 volts rms. Adjust the output of the power source to provide 115 volts rms output (85.3 per cent of rated output voltage) at 400 Hz. Connect a 132 ohm (100 VA) load to the output terminals at the rear of the power source and check that the regulation control has been set to provide a zero output impedance.

4.8.2 Connect an AC expanded scale (about 115 volts rms) strip chart recorder across the output terminals of the power source and record the drift during a 24 hour period. This drift should be less than ±.29 volts rms. Disregard the drift during the first hour, as this represents initial warm-up drift. Care should be taken to insure that the ambient temperature is held constant at ±3 degrees C for this test.

4.9 FREQUENCY RESPONSE

4.9.1 Connect the Model 101T Power Source as shown in Figure 4-3. Adjust the input AC line voltage to 115 volts rms. Adjust the output of the power source to provide 135 volts output (100 per cent of rated output voltage) at 400 Hz.

4.9.2 Vary the output frequency of the oscillator from 45 Hz to 10 KHz and monitor the output voltage of the power source

with a differential voltmeter under no-load conditions. The output of the power source should vary less than ±8.0 volts rms from 45 Hz to 10 KHz.

4.9.3 Close switch S1 and repeat 4.9.1 and 4.9.2. The output of the power source should vary less than ±8.0 volts rms for 45 Hz to 10KHz.

4.10 AC NOISE LEVEL

4.10.1 Connect the Model 101T Power Source as shown in Figure 4-3. Adjust the line voltage to 115 volts rms. Adjust the output of the power source to provide 105 volts rms (78% of rated output voltage) at 400 Hz.

4.10.2 Close switch S2 and monitor the output of the power source with the Tektronix 533A Oscilloscope with a "W" plug-in. Using the offset feature of the "W" plug-in, observe the positive peak of the output voltage at a vertical sensitivity of .2 volt per centimeter and a sweep rate of 5 milliseconds per centimeter. The peak-to-peak noise and ripple should not exceed 0.093 volts (70 dB below full output). The noise and ripple output may be slightly greater if the power source is tested at an output frequency of less than 200Hz.

4.10.3 Remove the plug-in oscillator and short pins 1 and 2 together of the small 12 pin terminal strip TB1 located on the rear panel of the Model 101T. The AC rms noise in the output should now be less than 10.5 millivolts rms (80 dB below full output) when read on the differential voltmeter. Remove the short from pins 1 and 2 of the TB1 and then insert the plug-in oscillator into the 101T.

4.11 0.7 LAGGING POWER FACTOR

4.11.1 Connect the Model 101T Power Source as shown in Figure 4-3. Figure 4-4 illustrates the load circuit and gives load parameter values for 100 VA 0.7 power factor at 400 Hz with 78 per cent of rated output voltage from the power source. This represents the worst case inductive load for maximum power dissipation inside the power source.

4.11.2 Set the oscillator frequency to 400 Hz and adjust the GAIN control for 78 per cent of rated output voltage. Check that the power source produces a stable output with no high-frequency oscillation or excessive distortion. Refer to Section 4.5 of this instruction manual for the procedure to measure harmonic distortion. This distortion must be less than 0.3 per cent at 400 Hz.

4.11.3 The regulation control usually does not require significant readjustment in order to provide a zero regulation with a 0.7 power factor load at 400 Hz. If the unit is to be operated at a 0.7 power factor in the high frequency region, i.e., 2KHz to 10KHz, then it may be necessary to readjust the regulation control. In this case, rotate the regulation control until zero regulation is obtained at the specific frequency and load condition.

4.11.4 The AC line input power is 400 watts maximum with an 0.7 power factor load at 78 percent of rated output voltage and an input line voltage of 125 volts rms.

4.11.5 The above tests may be repeated at frequencies other than 400Hz provided that the inductance of the series inductor is changed inversely proportional to the absolute value to the test frequency. For example, at 1KHz, the inductance value must be divided by 2.5. The series resistance value remains unchanged.

4.12 0.7 LEADING POWER FACTOR

4.12.1 Connect the Model 101T Power Source as shown in Figure 4-3. Figure 4-5 illustrates the load circuit and gives load parameter values for 100 VA, 0.7 power factor operation at 400Hz with 78 percent of rated output voltage from the power source. This represents the worst case capactive load for maximum power dissipation inside the power source.

4.12.2 Set the oscillator frequency to 400Hz and adjust the GAIN control for 78 percent of rated output voltage. Check that the power source produces a stable output with no high-frequency oscillation or excessive distortion. Refer to Section 4.5 of this instruction manual for the procedure to measure harmonic distortion. This distortion must be less than 0.3 percent at 400Hz.

4.12.3 The regulation control usually does not require significant readjustment in order to provide zero regulation with a 0.7 power factor load at 400Hz. If the unit is to be operated at 0.7 power factor in the high frequency region, i.e., 2KHz to 10KHz, then it may be necessary to readjust the regulation control until zero regulation is obtained at the specific frequency and load condition.

4.12.4 The AC line input power is 400 watts maximum with an 0.7 power factor load at rated output voltage and an input line voltage of 125 volts rms.

4.12.5 The above tests may be repeated at frequencies other than 400Hz, provided that the capacitance of the series capacitor is changed inversely proportional to the absolute value of the test frequency. For example, at 1KHz, the capacitance value must be divided by 2.5. The series resistance value remains unchanged.

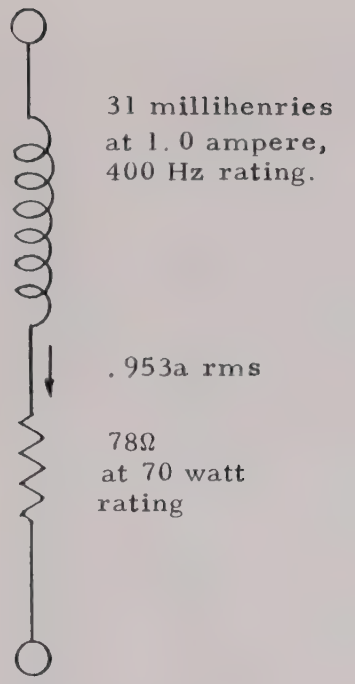


FIGURE 4-4. Circuit for 100VA, 0.7 Lagging Power Factor Load at 400 Hz.

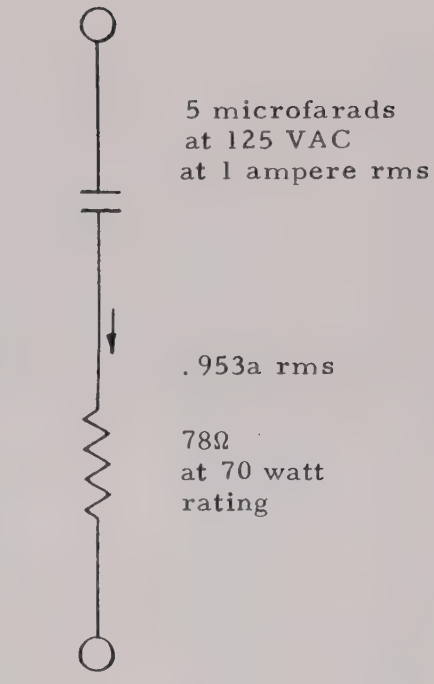


FIGURE 4-5. Circuit for 100VA, 0.7 Leading Power Factor Load at 400 Hz.

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL

The California Instruments Model 101T Power Source is a solid state unit and should require a minimum of maintenance. However, it is forced air cooled and will accumulate some dust with time. The power transistor heatsinks should receive a forced air bath at intervals not to exceed 6 months.

CAUTION

Failure to keep the heatsinks clean will reduce their thermal transfer efficiency somewhat and could cause failure of the power source.

5.2 TROUBLESHOOTING

5.2.1 If a problem appears in the power source, it must be isolated to a specific section of the unit. Before servicing the amplifier, check that the AC power input to the unit is of the proper amplitude and frequency. Check that the signal input to the power amplifier is also of the proper amplitude (approximately 5 volts rms) and frequency (45 Hz to 10 KHz). Check that the output load on the power amplifier is not excessive or that the load starting transients are not excessive. Check that the output of the oscillator is coupled to the input of the power amplifier through the 12 pin connector on the rear of the power amplifier.

5.2.2 If the problem has been resolved to be in the power amplifier, first check all DC power supply voltages. Information concerning power supply ripple and voltage tolerance is given in section 3.2.6 of this instruction manual.

5.2.3 Check that the quasi complementary symmetry output amplifier is operating properly and is not drawing excessive current under no load conditions. Section 3.2.2 of this instruction manual describes the operation of this output amplifier.

5.2.4 Check that the overload circuitry is operating properly. The overload circuit may be disabled by removing A1CR13.

5.2.5 If the problem has been resolved to be in the oscillator, consult the applicable oscillator instruction manual.

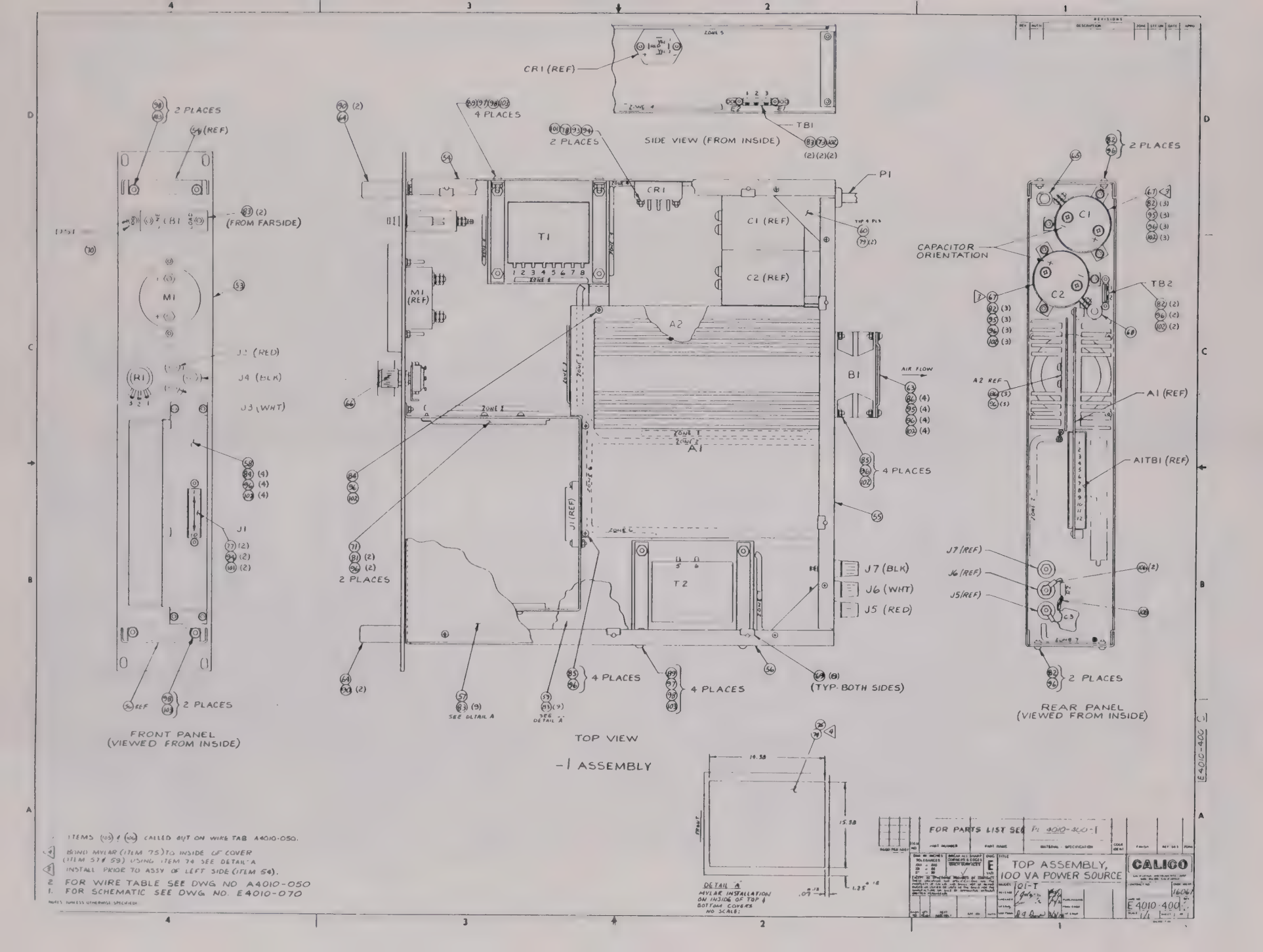
6.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 101T AC Power Source. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

6.2 REFERENCE DESIGNATIONS

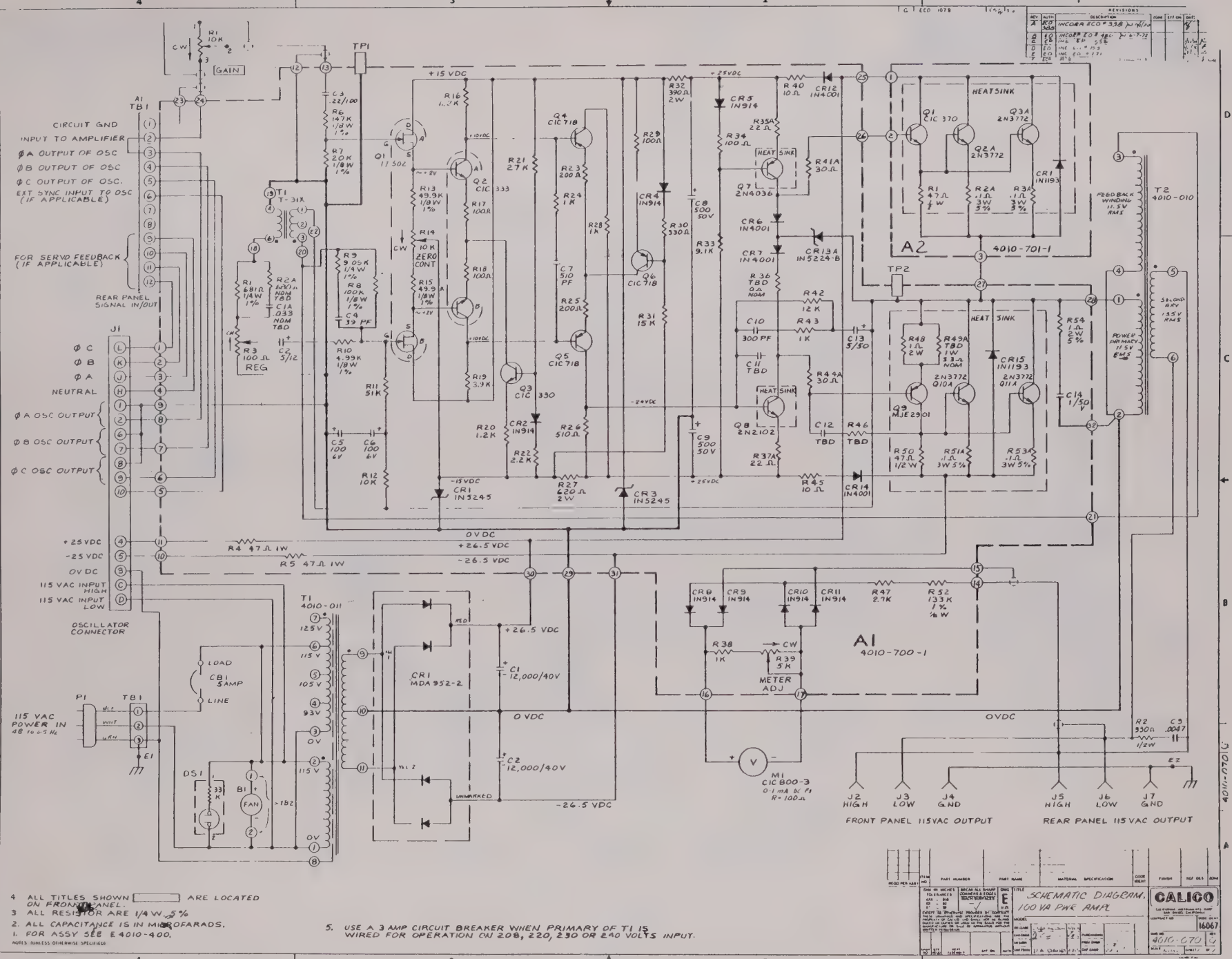
Partial reference designators are shown on schematic and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference designator. For example:

Assembly/Sub-Assembly	Component	Component Designation
A1	C14	A1C14
None	T1	T1
A2	R1	A2R1



1. ITEMS (103) & (104) CALLED OUT ON WIRE TAB A4010-050.
2. FOR WIRE TABLE SEE DWG NO A4010-050
1. FOR SCHEMATIC SEE DWG. NO. E4010-070

UNLESS UNLESS OTHERWISE SPECIFIED



4 ALL TITLES SHOWN [ ] ARE LOCATED ON FRONT PANEL.

3 ALL RESISTOR ARE 1/4 W 5%

2. ALL CAPACITANCE IS IN MICROFARADS.

1. FOR ASSY SEE E 4010-400.

NOTES: UNLESS OTHERWISE SPECIFIED

5. USE A 3 AMP CIRCUIT BREAKER WHEN PRIMARY OF T1 IS WIRED FOR OPERATION ON 208, 220, 230 OR 240 VOLTS INPUT.

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	APRD

NOTE:

1. FOR SCHEMATIC DIAGRAM SEE DWG NO. E4010-070 FOR -1 & E4016-070 FOR -2
2. APPLY ITEM 139 BETWEEN Q9, Q10, Q11, CR15 AND HEATSINK. USE MICA INSULATOR ONLY UNDER Q9
3. MOUNT R48, R49, R50, R51, R53 ON HEATSINK SURFACE.
4. MOUNT R27, R32, R54 1/8" OFF OF PC BOARD.
5. Q9, Q10, Q11, & T1 MOUNTING NUT TO BE ON TRANSISTOR SIDE AS SHOWN. SCREW HEAD TO BE ON CLAD SIDE OF P.C. BOARD.

VIEW A-A
NO SCALE

INSTALLATION OF R51 & R53
FOR -2 ASSY ONLY

-1 ASSY FOR MODEL 101T
-2 ASSY FOR MODEL 161T

X		P/L 4010-700-2	PARTS LIST	SHEETS 5 THRU 0						
	X	P/L 4010-700-1	PARTS LIST	SHEETS 6 THRU 0						
-2	-1	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE	
QD PER ASSY										

DIM IN INCHES
TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES

DWG SIZE D

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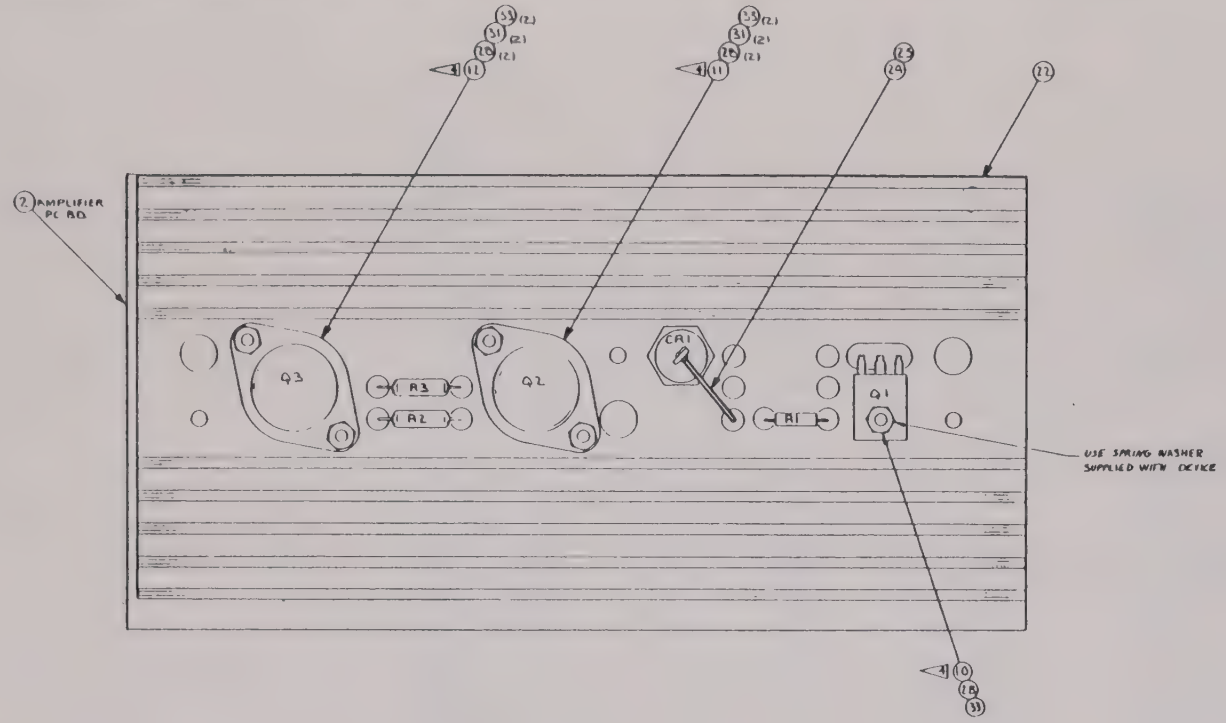
TITLE: AMPLIFIER PC BOARD #1 (ASSEMBLY) A1

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-2	1	E4016-400		
-1	1	E4010-400		

MODEL	101T → 161T	CONTRACT NO.	CODE IDENT 16067
RELEASE	[illegible] 3-2-70		
CHECKER	[illegible]	PURCHASING	DWG NO. D4010-700 REV X
DESIGN	CW 3-18-70	PROJ ENGR	
DRFTSMN	CW 3-18-70	CHF ENGR	SCALE 2:1 SHEET 1 OF 10

CALICO P-303



INSTALLATION OF R2 & R3
FOR -2 ASSY ONLY

-1 PC BOARD ASSY (FOR MODEL 101T)
VIEW COMPONENT SIDE
-2 PC BOARD ASSY (FOR MODEL 161T)

4 TRANSISTOR MOUNTING NUTS TO BE ON TRANSISTOR SIDE AS SHOWN SCR HEADS TO BE ON CLAD SIDE OF P.C. BD SOLDER SCR HD TO CLAD.
3. MOUNT R1, R2 & R3 FLUSH WITH HEATSINK
2. APPLY ITEM 23 BETWEEN Q1, Q2, Q3, CR1 AND HEATSINK, DO NOT USE MICA WASHER.
1. FOR SCHEMATIC DIAGRAM SEE DWG NO. E4010-070 FOR -1 & E4016-070 FOR -2

NOTE:

ITEM NO	PART NUMBER	PART NAME	MATERIAL SPECIFICATION	CODE IDENT	FINISH	REF DES	FSCM
X -2 -1	PA 4010-701-2 PA 4010-701-1	PARTS LIST PARTS LIST	SHEET 4 SHEET 4				
2	1	E4016-400					
1	1	E 4010 400					

DWG NO D-4010-701 REV 12
SCALE 2:1 SHEET 2 OF 4

REPLACEABLE PARTS

7.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alphanumerical order of their reference designators. Description, manufacturers' part number, manufacturers' code ident number (see Appendix A for list of manufacturers), and California Instruments' stock number are indicated.

7.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument.

b) California Instruments part number of the sub-assembly where component is located.

c) Component reference designator.

d) Component description.

e) Component manufacturer's number and code ident.

f) California Instruments stock number.

All replacement parts orders should be placed with California Instruments, Division of Amstar Technical Products Co., Inc., San Diego, California, 92111-1266.

7.3 COMPUTER GENERATED PARTS LISTS

The following information is included as an explanation of the computer formatted parts list column.

7.3.1 "Seq. No." - Sequence number; the reference designator or the component, or (if there is no reference designator) the balloon number (bubble or "find" number) on the face of the assembly drawing or the top assembly drawing. They are listed in alphanumerical order.

7.3.2 "Component Item No." - This is California Instruments part number. Please use this number when ordering spares.

7.3.3 "Description, Truncated" - A brief description of the item. Abbreviations are per MIL-STD-12 or industry accepted standards.

7.3.4 "Engineering Drawing No." - This is used for one of the following:

a) The document/specification number generated by California Instruments to control the part.

b) The generic part number (military specification or industry accepted standard).

c) The primary vendor's catalog part number. An asterisk at the end of the number indicates number is longer than that shown (contact California Instruments if the full number is required).

7.3.5 "Vendor" - This is the FSCM code identification (see Appendix A).

7.3.6 "Quan" and "U/M" - The requirements per unit of measure such as: "2 each"; "1 lb."; "4 oz."; or "6 SI" (square inches).

CALICO | CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA | CODE IDENT 16067 | PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	Std. 101T AC Power Source from Finished Goods				
					1
Remove from Std. 101T					2
M1	C1C800-3	Meter	16067	2-50105	4
					5
T2	4010-010	Output Transformer	16067	7-10193	6
					7
A1R47	RC07GF272J	Resistor 2.7K 1/4W 5%	81349	5-10062	8
A1R52	RN60C1333F	Resistor 133K 1/8W 1%	81349	5-60329	9
					10
R2	RC20GF331J	Resistor 330Ω 5% 1/2W	81349	5-20026	11
C3	6DP-1-472	Capacitor .0047 μF	04062	6-10547	12
					13
					14
Add to Std. 101T					15
					16
M1	C1C 800-7	Meter 40V	16067	2-50158	17
					18
T2	4010-015	Output Transformer	16067	7-10210	19
					20
A1R47	24 Ga Buss	Jumper	-	-	21
A1R52	RN60C2492F	Resistor 33.2K 1/8W 1%	81349	5-60249	22
					23
R2	RC20GF220J	Resistor 22Ω 1/2W 5%	81349	5-20008	24
C3	4DP-3-683	Capacitor .068 μF	04062	6-10792	25
					26
					27
					28
					29
					30
					31
					32
					33
					34
					35

MODEL 101T-638 | CALICO P/N 4995-410 | ASSY R.D.

TITLE 100VA AC Power Source 35V Output | SHT 2 OF 2

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
	4010-050	HARNESS ASSY,JUMPER	4010-050	16067	1.0	EA
	4010-050-1	HARNESS ASSY	4010-050-1	16067	1.0	EA
	4010-453-1	FRONT PANEL ASSY	4010-453-1	16067	1.0	EA
CB1	270016	CIRCUIT BREAKER,5A,250V	AM12-5-250-5-*	74193	1.0	EA
DS1	241021	LAMP,GAS,AMBER,120V	8G03ACSNE2H/33K	03797	1.0	EA
J2	240041	BINDING POST,RED	DF-31RC	58474	1.0	EA
J3	240090	BINDING POST,WHT	DF-31WTC	58474	1.0	EA
J4	240040	BINDING POST,BLK	DF-31BC	58474	1.0	EA
M1	CIC800	METER,DC,ANLG,MA,0-1	CIC800-0	16067	1.0	EA
M1	CIC800-3	METER W/4010-013	CIC800-3	16067	1.0	EA
R1	570128	POT,PNL,10K,1/2W,PREC	B4010-012-1	16067	1.0	EA
53	110176-1	PANEL,FRONT W/4010-200	4010-200-1	16067	1.0	EA
58	110181	BRACKET,PLUG-IN OSC.	4010-205-1	16067	1.0	EA
64	240226	HANDLE,FLT,S/S,3"	11515-S-0832-4	06540	2.0	EA
66	240233	KNOB,BLK	PS-70-2-BLK	21604	1.0	EA
71	241124	GUIDE,PWB,4.15"	33-9016-12-01-*	91662	2.0	EA
	4010-454-1	REAR PANEL ASSY	4010-454-1	16067	1.0	EA
B1	241059	FAN,3"115VAC,50/60HZ	8500	23936	1.0	EA
C1	610716	CAP,AL,12,000UF,40V	36D123G040BC2A	56289	1.0	EA
C2	610716	CAP,AL,12,000UF,40V	36D123G040BC2A	56289	1.0	EA
C3	610547	CAP,MYLAR,.0047UF,600V	6DP-1-472	72136	1.0	EA
J5	240041	BINDING POST,RED	DF-31RC	58474	1.0	EA
J6	240090	BINDING POST,WHT	DF-31WTC	58474	1.0	EA
J7	240040	BINDING POST,BLK	DF-31BC	58474	1.0	EA
P1	241065	PWR CORD,115V,18-3,6'	17405	70903	1.0	EA
R2	520026	RES,CARB,1/2W,330 OHM	RC20GF331J	81349	1.0	EA
TB2	250111	TERMINAL STRP, 2TERM,2MT	3002	83330	1.0	EA
55	110779-1	PANEL,REAR W/4010-236	4010-236-1	16067	1.0	EA
63	240287	FAN GUARD	55081	23936	1.0	EA
65	240205	STRAIN RELIEF	SR6P3-4	28520	1.0	EA
67	610717	CAP CLAMP,2"	4586-48	56289	2.0	EA
68	210105	GROMMET,RUBBER,5/16"DIA	2172	83330	1.0	EA
	4010-455-1	SIDE RAIL ASSY,LEFT	4010-455-1	16067	1.0	EA
CR1	310188	BRDG,RECT,FW,8A,100V,298	MDA801	04713	1.0	EA
TB1	250050	TERMINAL STRP, 3TERM,2MT	3003	83330	1.0	EA
T1	710194	TRANSFORMER,INPUT	4010-011-1	16067	1.0	EA
54	110177	SIDE RAIL,LEFT	4010-201-7	16067	1.0	EA
73	250047	LUG,RING,SOLDER,#6	1416-6	83330	2.0	EA
	4010-456-1	SIDE RAIL ASSY,RIGHT	4010-456-1	16067	1.0	EA
T2	710193	TRANSFORMER,OUTPUT	4010-010-1	16067	1.0	EA
56	110179	SIDE RAIL,RIGHT	4010-203-7	16067	1.0	EA
A1	4010-700-1	PC ASSY,AMPLIFIER	4010-700-1	16067	1.0	EA
A2	4010-701-1	HEATSINK ASSY,OUT DRIVER	4010-701-1	16067	1.0	EA
J1	410032	CONN,PC EDGE,10 PIN	8B010S-0	81312	1.0	EA
57	110180	COVER,TOP	4010-204-7	16067	1.0	EA
59	110180	COVER,TOP	4010-204-7	16067	1.0	EA
60	110191	GUSSET	4010-209-1	16067	4.0	EA
69	210091	NUT,SPEED,6-32	C8020-632	78553	10.0	EA
74	FS4004	ADHESIVE,SPRAY	77	04963	.2	OZ
75	FS4005	MYLAR,.003 THK,NATURAL	MULAR,.003 THK	81349	442.0	SI
77	FS1018	SCREW,PNH,S/S,4-40X1/2	MS51957-17	81349	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
78	FS1023	SCREW,FLH,S/S,4-40X1	MS24693-C10	81349	2.0	EA
79	FS1014	SCREW,FLH,S/S,4-40X1/4	MS24693-C2	81349	2.0	EA
81	FS1026	SCREW,PNH,S/S,6-32X1/4	MS51957-26	81349	4.0	EA
82	FS1028	SCREW,PNH,S/S,6-32X5/16	MS51957-27	81349	14.0	EA
83	FS1001	SCREW,FLH,S/S,6-32X5/16	MS24693-C25	81349	20.0	EA
84	FS1029	SCREW,FLH,S/S,6-32X3/8	MS24693-C26	81349	5.0	EA
85	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	81349	8.0	EA
86	FS1031	SCREW,PNH,S/S,6-32X7/16	MS51957-29	81349	7.0	EA
89	FS1049	SCREW,PNH,S/S,8-32X7/16	MS51957-44	81349	8.0	EA
90	FS1044	SCREW,FLH,S/S,8-32X1/2	MS24693-C50	81349	4.0	EA
93	FS1079	WASHER,FLAT,S/S,#4	MS15795-804	81349	2.0	EA
94	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	4.0	EA
95	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	81349	10.0	EA
96	FS1069	WASHER,INTER,S/S,#6	MS35333-71	81349	38.0	EA
97	FS1081	WASHER,FLAT,S/S,#8	MS15795-841	81349	8.0	EA
98	FS1070	WASHER,INTER,S/S,#8	MS35333-72	81349	12.0	EA
101	FS1066	NUT,HEX,S/S,4-40	MS35649-244	81349	4.0	EA
102	FS1064	NUT,HEX,S/S,6-32	MS35649-264	81349	12.0	EA
103	FS1065	NUT,HEX,S/S,8-32	MS35649-284	81349	12.0	EA
108	FS6003	TUBING,SHRINK,1/4	CP221-1/4-BLK	24011	1.0	IN

PARENT ITEM NO. 4010-700-1 | DESCRIPTION PC ASSY,AMPLIFIER
ENGR DRAW 4010-700-1 |

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
CR1	310067	DIODE,ZNR,15V,.5W,10%	1N5245	04713	1.0	EA
CR2	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR3	310067	DIODE,ZNR,15V,.5W,10%	1N5245	04713	1.0	EA
CR4	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR5	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR6	310172	DIODE,RECT,(USE 310062)	1N4001	04713	1.0	EA
CR7	310172	DIODE,RECT,(USE 310062)	1N4001	04713	1.0	EA
CR8	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR9	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR10	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR11	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR12	310172	DIODE,RECT,(USE 310062)	1N4001	04713	1.0	EA
CR13	310194	DIODE,ZNR,2.8V,.5W,5%	1N5224B	04713	1.0	EA
CR14	310172	DIODE,RECT,(USE 310062)	1N4001	04713	1.0	EA
CR15	310190	DIODE,RECT,(USE 310221)	1N1193	07716	1.0	EA
C1	610732	CAP,MYLAR,.033UF,100V	225P33391	56289	1.0	EA
C2	610708	CAP,AL,5UF,12V	TE1127	56289	1.0	EA
C3	610566	CAP,MYLAR,.22UF,100V	1DP-3-224	72136	1.0	EA
C4	610013	CAP,MICA,39PF,500V	CM05E390J03	81349	1.0	EA
C5	610375	CAP,AL,100UF,6V	TE1102	56289	1.0	EA
C6	610375	CAP,AL,100UF,6V	TE1102	56289	1.0	EA
C7	610046	CAP,MICA,510PF,500V	CM06F511J03	81349	1.0	EA
C8	610187	CAP,AL,500UF,50V	TC50050C	90201	1.0	EA
C9	610187	CAP,AL,500UF,50V	TC50050C	90201	1.0	EA
C10	610041	CAP,MICA,300PF,500V	CM05F301J03	81349	1.0	EA
C11	FS7002	CAP,TBD	TBD	81349	.0	EA
C12	FS7002	CAP,TBD	TBD	81349	.0	EA
C13	610331	CAP,AL,5UF,50V	TE1303	56289	1.0	EA
C14	610721	CAP,MYLAR,1.0UF,100V	112A1B105M	14752	1.0	EA
Q1	330293	TRANSISTOR,FET,N,DUAL	IT502	32293	1.0	EA
Q2	330012	TRANSISTOR,SS,NPN,DUAL	CIC333	16067	1.0	EA
Q3	330008	TRANSISTOR,SS,NPN,TO18	CIC330	16067	1.0	EA
Q4	330041	TRANSISTOR,SS,PNP,TO18	CIC718	16067	1.0	EA
Q5	330041	TRANSISTOR,SS,PNP,TO18	CIC718	16067	1.0	EA
Q6	330041	TRANSISTOR,SS,PNP,TO18	CIC718	16067	1.0	EA
Q7	330106	TRANSISTOR,SS,PNP,TO39	2N4036	04713	1.0	EA
Q8	330075	TRANSISTOR,SS,NPN,TO39	2N2102	81349	1.0	EA
Q9	330193	TRANSISTOR,PWR,PNP,TO220	MJE2901	04713	1.0	EA
Q10	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
Q11	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
R1	560017	RES,FILM,1/4W,681 OHM,1%	RN60D6810F	81349	1.0	EA
R2	510049	RES,CARB,1/4W,680 OHM	RC07GF681J	81349	1.0	EA
R3	570107	POT,1T,PC,100 OHM,1/4W	U-201R1018	71450	1.0	EA
R4	530068	RES,CARB,1W,47 OHM	RC32GF470J	81349	1.0	EA
R5	530068	RES,CARB,1W,47 OHM	RC32GF470J	81349	1.0	EA
R6	560340	RES,FILM,1/4W,147K,1%	RN60C1473F	81349	1.0	EA
R7	560239	RES,FILM,1/4W,20K,1%	RN60C2002F	81349	1.0	EA
R8	560131	RES,FILM,1/4W,100K,1%	RN60C1003F	81349	1.0	EA
R9	560196	RES,FILM,1/4W,9.09K,1%	RN60D9091F	81349	1.0	EA
R10	560238	RES,FILM,1/4W,4.99K,1%	RN60C4991F	81349	1.0	EA
R11	510093	RES,CARB,1/4W,51K OHM	RC07GF513J	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
R12	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R13	560114	RES,FILM,1/4W,49.9K,1%	RN60C4992F	81349	1.0	EA
R14	570035	POT,1T,PC,10K,1/4W	U201R103B	71450	1.0	EA
R15	560114	RES,FILM,1/4W,49.9K,1%	RN60C4992F	81349	1.0	EA
R16	510071	RES,CARB,1/4W,6.2K OHM	RC07GF622J	81349	1.0	EA
R17	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R18	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R19	510066	RES,CARB,1/4W,3.9K OHM	RC07GF392J	81349	1.0	EA
R20	510055	RES,CARB,1/4W,1.2K OHM	RC07GF122J	81349	1.0	EA
R21	510086	RES,CARB,1/4W,27K OHM	RC07GF273J	81349	1.0	EA
R22	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	EA
R23	510036	RES,CARB,1/4W,200 OHM	RC07GF201J	81349	1.0	EA
R24	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R25	510036	RES,CARB,1/4W,200 OHM	RC07GF201J	81349	1.0	EA
R26	510046	RES,CARB,1/4W,510 OHM	RC07GF511J	81349	1.0	EA
R27	540003	RES,CARB,2W,620 OHM	RC42GF621J	81349	1.0	EA
R28	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R29	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R30	510041	RES,CARB,1/4W,330 OHM	RC07GF331J	81349	1.0	EA
R31	510080	RES,CARB,1/4W,15K OHM	RC07GF153J	81349	1.0	EA
R32	540028	RES,CARB,2W,390 OHM	RC42GF391J	81349	1.0	EA
R33	510075	RES,CARB,1/4W,9.1K OHM	RC07GF912J	81349	1.0	EA
R34	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R35	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	EA
R36	FS5118	WIRE,BUS,MIL-W-3861 "S"	AWG 24	81349	1.0	IN
R37	510013	RES,CARB,1/4W,22 OHM	RC07GF220J	81349	1.0	EA
R38	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R39	575036	POT,1T,PC,5K,1/4W	U201R502B	71450	1.0	EA
R40	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R41	510016	RES,CARB,1/4W,30 OHM	RC07GF300J	81349	1.0	EA
R42	510078	RES,CARB,1/4W,12K OHM	RC07GF123J	81349	1.0	EA
R43	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R44	510016	RES,CARB,1/4W,30 OHM	RC07GF300J	81349	1.0	EA
R45	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R46	FS7000	RES,CARB,1/4W,TBD	RC07GF...	81349	1.0	EA
R47	510062	RES,CARB,1/4W,2.7K OHM	RC07GF272J	81349	1.0	EA
R48	540001	RES,CARB,2W,1 OHM	BWH 1 OHM	07716	1.0	EA
R49	FS7001	RES,CARB,2W,TBD	RC42GF...	81349	1.0	EA
R50	520013	RES,CARB,1/2W,47 OHM	RC20GF470J	81349	1.0	EA
R51	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
R52	560329	RES,FILM,1/4W,133K,1%	RN60C1333F	81349	1.0	EA
R53	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
R54	540001	RES,CARB,2W,1 OHM	BWH 1 OHM	07716	1.0	EA
TB1	241123	TERMINAL BLK,12TERM, 5A	410-Y-12	75382	1.0	EA
TP1	410155	TEST JACK,PC,VERT,BRN	105-0858-001	74970	1.0	EA
TP2	410156	TEST JACK,PC,VERT,RED	105-0852-001	74970	1.0	EA
T1	710130	TRANSFORMER	T31X	81095	1.0	EA
2	160101	PWB,AMPLIFIER	4010-750-1	16067	1.0	EA
6	210303	STANDOFF,SWGE,6-32 X 1/4	150B-1/4	88245	3.0	EA
132	240120	HEATSINK	TXBF-032-025B	98978	2.0	EA
133	240296	SOCKET,XSTR,TO-5	RCT05075-7A	19080	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
134	240297	SOCKET,XSTR,TO-18	RCTO18110-1A	19080	4.0	EA
135	110167	BRACKET,ANGLE	129515	73734	2.0	EA
136	210166	FSTNR,RVT,BRS,1/8X.156	1236	73734	2.0	EA
137	110183	HEATSINK	4010-206-7	16067	1.0	EA
138	FS5121	WIRE,BUS,MIL-W-3861 "S"	AWG 18	81349	1.0	IN
139	FS4001	THERMAL COMPOUND	THERMALCOTE	13103	.1	OZ
140	FS6011	TUBING,TEFLON,AWG 18	TFT-200-18-NAT.	92194	1.0	IN
141	FS5120	WIRE,BUS,MIL-W-3861 "S"	AWG 20	81349	1.0	IN
142	FS1006	SCREW,PNH,S/S,4-40X5/16	MS51957-14	81349	1.0	EA
143	250090	JUMPER,TERMINAL BLOCK	410J	75382	1.0	EA
146	FS1032	SCREW,PNH,S/S,6-32X1/2	MS51957-30	81349	5.0	EA
150	FS1068	WASHER,INTER,S/S,#4	MS35333-70	81349	4.0	EA
151	FS1069	WASHER,INTER,S/S,#6	MS35333-71	81349	5.0	EA
154	FS1066	NUT,HEX,S/S,4-40	MS35649-244	81349	2.0	EA
155	FS1064	NUT,HEX,S/S,6-32	MS35649-264	81349	4.0	EA

PARENT ITEM NO. 4010-701-1 DESCRIPTION HEATSINK ASSY,OUT DRIVER ENGR DRAW 4010-701-1

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
CR1	310190	DIODE,RECT,(USE 310221)	1N1193	07716	1.0	EA
Q1	330220	TRANSISTOR,PWR,NPN,TO220	CIC370	16067	1.0	EA
Q2	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
Q3	330173	TRANSISTOR,PWR,NPN,TO3	61491 (2N3772)	86684	1.0	EA
R1	520013	RES,CARB,1/2W,47 OHM	RC20GF470J	81349	1.0	EA
R2	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
R3	550188	RES,PWR,3W,.1 OHM,5%	RW69VR10WL	81349	1.0	EA
2	160102	PWB,HEATSINK,OUT DRIVER	4010-701-7	16067	1.0	EA
22	110183	HEATSINK	4010-206-7	16067	1.0	EA
23	FS4001	THERMAL COMPOUND	THERMALCOTE	13103	.1	OZ
24	FS5121	WIRE,BUS,MIL-W-3861 "S"	AWG 18	81349	1.0	IN
25	FS6011	TUBING,TEFLON,AWG 18	TFT-200-18-NAT.	92194	1.0	IN
28	FS1032	SCREW,PNH,S/S,6-32X1/2	MS51957-30	81349	5.0	EA
31	FS1069	WASHER,INTER,S/S,#6	MS35333-71	81349	4.0	EA
33	FS1064	NUT,HEX,S/S,6-32	MS35649-264	81349	5.0	EA

Appendix A

Code	Name	City	State
0000A	Electricord	Westfield	PA
0000C	Jackson Bros.	Waddon, Surrey	GB
0000S	OPCDA	Edison	NJ
0000W	Milton Ross Co.	Southampton	PA
0000Z	Timco	Los Angeles	CA
000AC	ITAC	Santa Clara	CA
000AD	Plessey	Westlake Village	CA
000AG	La France	Philadelphia	PA
000AH	Jan Crystal	Ft. Myers	CA
000AL	Data Components, Inc.	Santa Monica	CA
000AM	Kraus & Naimer	Santa Monica	CA
000AN	Ritz Instrument Transformer Co.	Redondo Beach	CA
000AS	Switches Incorporated	Mt. View	CA
00544	Metal-Cal Div., Avery Prod. Corp.	Inglewood	CA
00779	AMP Inc.	Harrisburg	PA
00853	Sangamo Electric Co.	Pickens	SC
00866	Goe Eng. Co., Inc.	City of Industry	CA
01002	G.E. Co., Ind. & Pwr. Cap. Dept.	John St. Hudson Falls	NY
01121	Allen-Bradley Co.	Milwaukee	WI
01139	G.E. Co., Silicone Products Dept.	Waterford	NY
01295	Texas Instruments	Dallas	TX
02111	Spectrol Electronics	City of Industry	CA
02335	Fairchild Controls Corp.	Hicksville, LI	NY
02375	American Insulating Machinery Co.	Philadelphia	PA
02538	Texas Electronics Co.	Dallas	TX
02660	Amphenol Corporation	Broadview	IL
02799	Use Code #72136		
02507	General Electric Company	Syracuse	NY
03508	General Electric Company	Syracuse	NY
03797	Eldema Corporation	Compton	CA
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls	NJ
03911	Clairex Corporation	New York	NY
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford	CT
04713	Motorola Semiconductor Prod., Inc.	Phoenix	AZ
04963	3-M	St. Paul	MN
05245	Corcom Inc.	Chicago	IL
05276	Pomona Electronics Co., Inc.	Pomona	CA
05397	Kemet, Union Carbide Corp.	Cleveland	OH
05820	Wakefield Engineering, Inc.	Wakefield	MA
06383	Panduit Corp.	Tinley Park	IL
06514	Stantron, Wyco Metal Products	N. Hollywood	CA
06540	Amathom Elect. Hardware	New Rochelle	NY
06665	Precision Monolithics Inc.	Santa Clara	CA
06776	Robinson Nugent, Inc.	New Albany	IN
06915	Richco Plastics, Co.	Chicago	IL
07088	Kelvin Electric Company	Van Nuys	CA
07263	Fairchild Camera and Instr. Corp.	Mt. View	CA
07387	Birtcher Corporation	Los Angeles	CA
07556	Unitrack Calabro Plastics	Upper Darby	PA
07633	Epoxy Prod. Co., Allied Prod. Corp.	New Haven	CT
07716	IRC Incorporated	Burrington	IA
08065	Accurate Rubber and Plastics Co.	San Diego	CA
08261	Spectra Strip	Garden Grove	CA
08289	Blinn-Delbert Co., Inc.	Pomona	CA
08353	Bristol Co.	Toronto	CANADA
08524	Deutsch Fastener Corp.	Los Angeles	CA
08730	Vemaline Products Co.	Franklin Lakes	NJ
08779	Signal Transformer Co.	Brooklyn	NY
09353	C and K Components	Newton	MA
10389	Chicago Switch Inc.	Chicago	IL
11815	Cherry Rivet Div., Townsend Co.	Santa Ana	CA
12406	Elpac, Incorporated	Fullerton	CA
12697	Clarostat Mfg. Co., Incorporated	Dover	NH
13103	Thermalloy Company	Dallas	TX
14099	Semtech Corporation	Newbury Park	CA
14604	Elmwood Sensors Inc.	Cranston	RI
14655	Cornell-Dubilier Elect. Corp.	Newark	NJ
14726	Hollingsworth Co.	Phoenixville	PA
14752	Electro Cube, Incorporated	San Gabriel	CA
15238	ITT Semiconductors	Lawrence	MA
15636	Elec-trol	Northridge	CA
15801	Fenwall Electronics	Framingham	MA
15818	Amelco Teledyne, Incorporated	Mt. View	CA
15912	Ansley	Los Angeles	CA
16067	California Instruments Company	San Diego	CA
16758	Delco Radio Div., General Motors	Kokomo	IN
16956	Dennison	Framingham	MS
18076	Umpco	City of Industry	CA
18178	Vactec, Inc.	Maryland Heights	Mo
18324	Signetics	Sunnyvale	CA
18612	Vishay Instruments Inc.	Malvern	PA
18677	Scambe Mfg. Co.	Monterey Park	CA
18722	RCA	Mountaintop	PA
18736	Voltronics Corp.	Hanover	NJ
19080	The Robinson Company	Hawthorne	CA
21604	Buckeye Stamping Company	Columbus	OH
22599	Elastic Stop Nut Corporation	Van Nuys	CA
23050	Product Components Corp.	Hastings-on-Hudson	NY
23936	Pamotor, Incorporated	San Francisco	CA
24011	ECC	Burlington	MA
24444	General Semiconductor Industries Inc.	Tempe	AZ
24796	Parelco Inc.	Paramount	CA
25497	Meter Master	Los Angeles	CA
26806	American Zettler, Inc.	Costa Mesa	CA
27014	National Semi-Conductor Corp.	Santa Clara	CA
27191	Cutler-Hammer, Inc.	Milwaukee	WI
27264	Mole	Downers Grove	IL
27556	IMB Electronic Products	Santa Fe Springs	CA
27685	Varo, Incorporated	[illegible]	TX
27832	Hughes Aircraft	Newport Beach	CA

Code	Name	City	State
28480	Hewlett-Packard Co.	Palo Alto	CA
28520	Heyman Mfg. Company (Heyco)	Kenilworth	NJ
30039	International Components Corp.	Asbury Park	NJ
30983	Electra/Midland (Mepco/Electra)	San Diego	CA
30161	Aavid Engineering Inc.	Laconia	NH
30897	Dorann Company	Sylmar	CA
31931	Tiridge Inc.	Pittsburgh	PA
32293	Intersil	Cupertino	CA
32559	Bivar, Inc.	Santa Ana	CA
33005	Jewell Electrical Instruments Inc.	Manchester	NH
33716	Kingsbacher Murray Co.	Los Angeles	CA
33855	Ducommun Inc.	Los Angeles	CA
34333	Silicon General	Westminster	CA
34649	Intel Corporation	Santa Clara	CA
44655	Ohmite Manufacturing Company	Skokie	IL
45722	Parker-Kalon	Clifton	NJ
46384	Penn. Eng. and Mfg. Corp.	Doylestown	PA
50522	Monsanto, Electronic Special Products	Cupertino	CA
51167	Aries Electronics Inc.	Frenchtown	NJ
51705	ICD/Rally	Palo Alto	CA
52072	Circuit Assembly Corp.	Costa Mesa	CA
54407	Power-One Co.	Camarillo	CA
56289	Sprague Electric Company	North Adams	MA
58474	Superior Electric Company	Bristol	CT
59730	Thomas and Betts Company	Elizabeth	NJ
63743	Ward Leonard Electric Co.	Mt. Vernon	NY
70318	Allmetal Screw Prod. Co.	Garden City	NY
70903	Belden Manufacturing Co.	Chicago	IL
71218	Bud Industries, Inc.	Willoughby	OH
71279	Cambridge Thermionic Corp.	Cambridge	MA
71400	Bussman Mfg. Div. McGraw-Edison Co.	St. Louis	MO
71450	CTS Corporation	Elkhart	IN
71468	ITT Cannon Electric Inc.	Los Angeles	CA
71590	Centralab Div. Globe-Union, Inc.	Milwaukee	WI
71707	Coto-Coil	Providence	RI
71744	Chicago Miniature Lampworks	Chicago	IL
71785	TRW Cinch	Chicago	IL
71984	Dow Corning Corp.	Midland	MI
72136	Elmenco (Electro Motive)	Willimantic	CT
72619	Dialight Corporation	Brooklyn	NY
72699	General Instruments	Newark	NJ
72982	Erie Technological Products Inc.	Erie	PA
73138	Beckman Instruments, Inc.	Fullerton	CA
73724	Federal Screw Products, Inc.	Chicago	IL
74193	Heinemann Electric Company	Trenton	NJ
74545	Harvey Hubbell, Inc.	Bridgeport	CT
74840	Illinois Condenser Co.	Chicago	IL
74970	E.F. Johnson Company	Waseca	MN
75042	TRW Electronic Components	Philadelphia	PA
75382	Kulka Electric Corporaion	Mt. Vernon	NY
75915	Littlefuse Incorporated	Des Plaines	IL
77122	United-Carr Inc., Fatwin Division	Waterbury	CT
77342	Potter and Brumfield Div., AMF	E. Princeton	IN
78189	Shakeproof Div., Illinois Tool Works	Chicago	IL
78553	Tinnerman Products, Inc.	Cleveland	OH
79136	Johns-Manville Products Corp.	Chicago	IL
79136	Waldes Kohinoor Inc.	Long Island City	NY
79963	Zierick Mfg. Corporation	New Rochelle	NY
80031	Mepco/Electra	Morristown	NJ
80223	United Transformer Co.	New York	NY
80294	Bourns, Incorporated	Riverside	CA
81095	Triad Transformer Corp.	Venice	CA
81312	Winchester Electronics	Oakville	CT
81349	Military Specification or Commercial Generic Number		
81603	Raco Products Co.	Chicago	IL
82104	Standard Grigsby	Aurora	IL
82389	Switchcraft, Incorporated	Chicago	IL
82877	Rotron Manufacturing Co., Inc.	Woodstock	NY
82893	Vector Electronics Inc.	Sylmar	CA
83330	Herman H. Smith, Inc.	Brooklyn	NY
83486	Elco Tool and Screw Corp.	Rockford	IL
86684	RCA	Harrison	NJ
87034	Marco-Oak Industries	Anaheim	CA
88245	Useco Div., Litton Industries	Van Nuys	CA
90201	Mallory Capacitor Company	Indianapolis	IN
91637	Dale Electronics, Inc.	Columbus	NE
91662	Elco Corporation	Willow Grove	PA
91833	Keystone Electronics Corp.	New York	NY
92194	Alpha Wire Corporation	Elizabeth	NJ
94222	Southco, Incorporated	Lester	PA
95303	RCA	Cincinnati	OH
95987	Weckesser Company, Inc.	Chicago	IL
97525	Electronic Engineering Co.	Santa Ana	CA
98159	Rubber Teck, Incorporated	Gardena	CA
98291	Sealecto Corp.	Mamaroneck	NY
98376	Zero Mfg. Co. (West)	Burbank	CA
98978	IERC	Burbank	CA
99743	IMC	Maywood	CA
99800	Delevan Electronics Corporation	Aurora	NY

Revision J
January 5, 1982

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS, Division of Amstar Technical Products Co., Inc., warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned freight prepaid, and when examination reveals that the fault has not occurred because of misuse, abnormal conditions of operation, user modification, or attempted user repair. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS will submit an estimate for such charges before commencing repair, if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or a Return Material Authorization (RMA) number will be given. Fill in RMA No. blank on shipping label attached opposite these instructions, pack instrument carefully to prevent transportation damage, affix label to shipping container, and ship freight prepaid to the factory. CALIFORNIA INSTRUMENTS shall not be responsible for repair of damage due to improper handling or packing. Instruments returned without RMA No., or freight collect will be refused. Instruments repaired under Warranty will be returned by prepaid surface freight. Instruments repaired outside the Warranty period will be returned freight collect, F.O.B. CALIFORNIA INSTRUMENTS, San Diego, CA. If requested, an estimate of repair charges will be made before work begins on repairs not covered by the Warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed immediately with the carrier. A full report of the damage should be obtained by the claim agent, and a copy of this report should be forwarded to us. CALIFORNIA INSTRUMENTS will prepare an estimate of repair cost, and repair the instrument when authorized by the claim agent. Please include model number and serial number when referring to the instrument.

From

California Instruments
Division of Norlin Industries
5150 Convoy Street
San Diego, California 92111

Attn: Customer Service

RMA NO. _____

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